Vol. 12, No. 18
September 30, 1987

# Energy Research Abstracts

Abstracts 36228-38418

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

# CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

# PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

***Energy Abstracts for Policy Analysis (EAPA)***

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $63.00 for domestic (North America) or $78.75 for foreign (outside North America) subscribers; a single issue is $6.00 or $7.50, respectively.

***Energy Research Abstracts (ERA)***

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

***DOE Patents Available for Licensing (PAL)***

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available as PB87-946800 from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 on a standing order basis through an NTIS Deposit Account. To establish an NTIS account, send the minimum $25.00 deposit to NTIS, Attn: Customer Accounts. A single issue is $12.00 for domestic (North America) and $24.00 for foreign (outside North America).

***Energy Meetings (EM)***

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)***–**PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)***–**PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)***–**PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)***–**PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)***–**PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)***–**PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)***–**PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)***–**PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)***–**PB87-900500.** Heavy-ion (A > 4) reactions.

***Laser Research (LAR)***–**PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)***–**PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)***–**PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)***–**PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)***–**PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)***–**PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)***–**PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

# INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

***Atomindex***

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

***Biomass Abstracts***

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

***Coal Abstracts***

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

International Copyright, © U. S. Department of Energy, 1987, under the provisions of the Universal Copyright Convention, United States copyright is not asserted under the United States Copyright Law, Title 17, United States Code.

energinfoERA™

Vol. 12, No. 18
ISSN: 0160-3604
CODEN: ERABD
September 30, 1987

# ENERGY RESEARCH ABSTRACTS

## ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

UNITED STATES DEPARTMENT OF ENERGY

**John S. Herrington**
Secretary

**Lawrence F. Davenport**
Assistant Secretary
Management and Administration

**Harry L. Peebles**
Director of Administration

**Joseph G. Coyne**
Manager
Office of Scientific and Technical Information

## ABOUT *ENERGY RESEARCH ABSTRACTS*

*Energy Research Abstracts (ERA)* provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

*ERA* is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

*ERA* is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

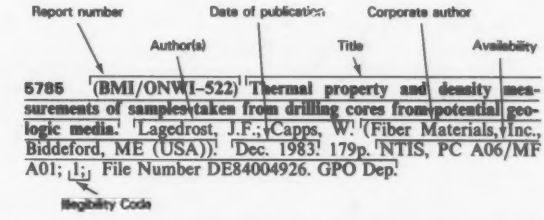
*ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

**Office of Scientific and Technical Information**
**United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831**

# HOW TO USE *ENERGY RESEARCH ABSTRACTS*

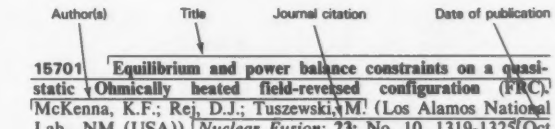
## ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; I; File Number DE84004926. GPO Dep.
Legibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

## INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

### • Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

**5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

**Fiber Materials, Inc., Biddeford, ME (USA)**

### • Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**Capps, W.,** *See* Lagedrost, J. F.
**Lagedrost, J.F.,** Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**McKenna, K.F.,** Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
**Rej, D.J.,** *See* McKenna, K.F.
**Tuszewski, M.,** *See* McKenna, K.F.

### • Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

**SALT DEPOSITS**
**Density**
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**REVERSED-FIELD PINCH**
**Energy Balance**
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

### • Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

| | | |
|---|---|---|
| **AC06-76RL01830** | **Fiber Materials, Inc., Biddeford, ME (USA)** | |
| | 9:5785 | BMI/ONWI-522 |

### • Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

| | | |
|---|---|---|
| **BMI/ONWI-522** | 9:5785 | NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70 |

# STAFF OF ENERGY RESEARCH ABSTRACTS

**Henry D. Raleigh,** Editor
**M. Catherine Grissom,** Assistant Editor

**Chemistry, Materials, and Biological Sciences Branch**
*Chief,* Vacant

**Scientific Analysts**
Polly S. Blackburn, *Environmental Sciences*
D. Lamar Cason, *Materials, Chemistry, and Electric Power*
Pamela L. Gorman, *Nuclear Fuels and Radio- and Radiation Chemistry*
Lorne T. Newman, *Coal*
Axel C. Ringe, *Geosciences and Life Sciences*
Amy T. Tamura, *Fossil Fuels*
Dennis T. Traylor, *Biological Sciences and Biomass*

**Nuclear Engineering and Physics Research Branch**
*Chief,* Lila Smith

**Scientific Analysts**
James D. Bales, *Nuclear Engineering*
Wanda R. Ferrell, *Atomic, Molecular, and Fluid Physics*
Douglas Lane, *Nuclear Physics*
Barry C. Steele, *Solar Energy*
Milton O. Whitson, *Fusion Energy*
Larry E. Williams, *High Energy Physics and Engineering*

Lawrence T. Whitehead, *Defense Programs*
David C. Cunningham, *Defense Programs*

**Subject Heading Specialist**
Mona H. Raridon

**Contract Number and Report Number Specialist**
Ramona N. Nelson

**Computer Processing Coordinator**
Billy H. Brady

**Corporate Author Specialist**
Patsy L. Hendricks

**International Exchange Coordinator**
Charles E. Stuber

**Publishing Coordinator**
Janice M. Blanton

Much of the information is provided by (1) bilateral exchange agreements with foreign organizations, and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

**Foreign Sources**

CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
London, England

International Atomic Energy Agency
International Nuclear Information System
Vienna, Austria

Nordic Energy Libraries
Risoe National Library
Roskilde, Denmark

Research Center
Netherlands Energy Research Foundation
Petten, Holland

United Kingdom of Great Britain and Northern Ireland
Department of Energy
London, England

**U. S. Sources**

American Institute of Physics
New York, NY

Department of Commerce
National Technical Information Service
Springfield, VA

Information Management Services, Inc.
Oak Ridge, TN

National Aeronautics and Space Administration
Scientific and Technical Information Division
Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

NOVA Information Services Company
Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

## SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

**01 COAL AND COAL PRODUCTS**
- 03 Preparation
- 04 Processing
- 05 By-Products
- 06 Properties
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves and Exploration
- 20 Mining
- 30 Transport and Handling
- 40 Combustion
- 50 Marketing and Economics
- 60 Health and Safety
- 70 Legislation and Regulations

**02 PETROLEUM**
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling and Production
- 04 Processing
- 05 Products and By-Products
- 06 Health and Safety
- 07 Marketing and Economics
- 08 Waste Management
- 09 Environmental Aspects
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Storage
- 50 Combustion

**03 NATURAL GAS**
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling, Production, and Processing
- 04 Products and By-Products
- 05 Health and Safety
- 06 Marketing and Economics
- 07 Waste Management
- 08 Environmental Aspects
- 09 Artificial Stimulation
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Combustion
- 50 Storage

**04 OIL SHALES AND TAR SANDS**
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 03 Drilling, Fracturing, and Mining
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 06 Direct Uses and By-Products
- 07 Health and Safety
- 08 Marketing and Economics
- 09 Waste Research and Management
- 10 Environmental Aspects
- 20 Regulations

**05 NUCLEAR FUELS**
- 01 Reserves, Exploration, and Mining
- 04 Feed Processing
- 05 Uranium Enrichment
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 10 Marketing, Economics, and By-Products
- 20 Waste Management
- 30 Environmental Aspects
- 40 Health and Safety
- 50 Safeguards, Inspection, and Accountability
- 60 Legislation and Regulations

**07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY**
- 01 Physical Isotope Separation
- 02 Radiation Sources
- 03 Isotopic Power Supplies
- 04 Economics

**08 HYDROGEN**
- 01 Production
- 02 Storage
- 03 Transport
- 04 Marketing and Economics
- 05 Safety
- 06 Industrial and Commercial Use
- 07 By-Products
- 08 Properties
- 09 Environmental Aspects

**09 OTHER SYNTHETIC AND NATURAL FUELS**
- 01 Hydrocarbon Fuels
- 02 Alcohol Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 04 Solid Waste and Wood Fuels
- 05 Liquid Waste Fuels
- 06 Gaseous Waste Fuels

**13 HYDRO ENERGY**
- 01 Resources and Availability
- 02 Site Geology and Meteorology
- 03 Plant Design and Operation
- 04 Regulations and Licensing
- 05 Economics and Management
- 06 Environmental Aspects
- 07 Power-Conversion Systems

**14 SOLAR ENERGY**
- 01 Resources and Availability
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 05 Solar Energy Conversion
- 06 Photovoltaic Power Systems
- 07 Solar Thermal Power Systems
- 08 Ocean Energy Systems
- 09 Solar Thermal Utilization
- 10 Solar Collectors and Concentrators
- 20 Heat Storage

**15 GEOTHERMAL ENERGY**
- 01 Resource Status and Assessment
- 02 Geology and Hydrology of Geothermal Systems
- 03 Geothermal Exploration and Exploration Technology
- 04 Legal and Institutional Aspects
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 07 By-Products
- 08 Geothermal Power Plants
- 09 Geothermal Engineering
- 10 Direct Energy Utilization
- 20 Geothermal Data and Theory

**16 TIDAL AND WAVE POWER**
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 07 Tidal Power Plants
- 08 Wave Energy Converters

**17 WIND ENERGY**
- 01 Availability (Climatology)
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 06 Wind Energy Engineering

**20 ELECTRIC POWER ENGINEERING**
- 01 Power Plants and Power Generation
- 02 Environmental Control Technology
- 03 Power Transmission and Distribution

**21 NUCLEAR POWER PLANTS**
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 05 Power Reactors, Breeding
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 07 Regulation and Licensing
- 08 Economics

**22 NUCLEAR REACTOR TECHNOLOGY**
- 01 Theory and Calculation
- 02 Components and Accessories
- 03 Fuel Elements
- 04 Control Systems
- 05 Environmental Aspects
- 06 Research, Test, and Experimental Reactors
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety

**25 ENERGY STORAGE**
- 01 Magnetic
- 02 Compressed Gas
- 03 Pumped Hydro
- 04 Capacitor Banks
- 05 Flywheels
- 06 Thermal
- 07 Liquefied Gas
- 08 Chemical
- 09 Batteries

**29 ENERGY PLANNING AND POLICY**
- 01 Energy Analysis and Modeling
- 02 Economics and Sociology
- 03 Environment, Health, and Safety
- 04 Natural Resources
- 05 Research, Development, Demonstration, and Commercialization
- 06 Nuclear Energy
- 07 Transport and Storage
- 08 Waste Heat Utilization
- 10 Conservation
- 20 Supply, Demand, and Forecasting
- 30 Policy, Legislation, and Regulation
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 60 Electric Power
- 80 Consumption and Utilization
- 90 Unconventional Sources and Power Generation

**30 DIRECT ENERGY CONVERSION**
- 01 MHD Generators
- 02 EHD Generators
- 03 Thermoelectric Generators
- 04 Thermionic Converters
- 05 Fuel Cells
- 08 Miscellaneous Converters

**32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION**
- 01 Buildings
- 02 Transportation
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 09 Education and Public Relations

**33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS**
- 01 Internal Combustion Engines
- 02 External Combustion Engines
- 03 Electric-Powered Systems
- 04 Hybrid Systems
- 05 Flywheel Propulsion
- 06 Vehicle Design Factors
- 07 Emission Control
- 08 Alternative Fuels

**35 ARMS CONTROL**
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

**36 MATERIALS**
- 01 Metals and Alloys
- 02 Ceramics, Cermets, and Refractories
- 06 Other Materials

**40 CHEMISTRY**
- 01 Analytical and Separations Chemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 04 Electrochemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry

**42 ENGINEERING**
- 02 Facilities and Equipment
- 03 Lasers
- 04 Heat Transfer and Fluid Flow
- 05 Materials Testing
- 08 Electronic Circuits and Devices
- 09 Waste Processing Plants and Equipment
- 10 Combustion Systems
- 20 Underground Engineering
- 30 Marine Engineering
- 40 Pollution Control Equipment
- 50 Power Cycles

**43 PARTICLE ACCELERATORS**
- 01 Design, Development, and Operation
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 03 Auxiliaries and Components
- 04 Storage Rings

**44 INSTRUMENTATION**
- 01 Radiation Instrumentation
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 03 Miscellaneous Instruments
- 04 Well Logging Instrumentation

**45 EXPLOSIONS AND EXPLOSIVES**
- 01 Chemical
- 02 Nuclear
- 03 Explosion Detection

**50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

**51 ENVIRONMENTAL SCIENCES, TERRESTRIAL**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

**52 ENVIRONMENTAL SCIENCES, AQUATIC**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

**53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES**
- 01 Social and Economic Studies
- 02 Assessment of Energy Technologies

**55 BIOMEDICAL SCIENCES, BASIC STUDIES**
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology

**55 BIOMEDICAL SCIENCES, BASIC STUDIES (CONT.)**
04 Genetics
05 Metabolism
06 Medicine
07 Microbiology
08 Morphology
09 Pathology
10 Physiological Systems
20 Public Health
30 Agriculture and Food Technology

**56 BIOMEDICAL SCIENCES, APPLIED STUDIES**
01 Radiation Effects
02 Thermal Effects
03 Chemicals Metabolism and Toxicology
04 Other Environmental Pollutant Effects

**57 HEALTH AND SAFETY**

**58 GEOSCIENCES**
01 Geology and Hydrology
02 Geophysics
03 Mineralogy, Petrology, and Rock Mechanics
04 Geochemistry
05 Oceanography

**64 PHYSICS I**
01 Astrophysics and Cosmology
02 Atmospheric Physics
03 Atomic, Molecular, and Chemical Physics
04 Fluid Physics
50 High Energy Physics

**65 PHYSICS II**
10 Nuclear Physics
12-20 Nuclear Properties and Reactions
30 Nuclear Theory
40 Radiation and Shielding Physics
50 Medical Physics
60 Condensed Matter Physics
61 Superconductivity
70 Theoretical and Mathematical Physics

**70 FUSION ENERGY**
01 Plasma Research
02 Fusion Power Plant Technology

**99 GENERAL AND MISCELLANEOUS**
01 Management
02 Mathematics and Computers
03 Information Handling
04 Law
05 Civilian Defense

**CORPORATE AUTHOR INDEX**

**PERSONAL AUTHOR INDEX**

**SUBJECT INDEX**

**CONTRACT NUMBER INDEX**

**REPORT NUMBER INDEX**

**FILE NUMBER CORRELATION**

## SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

**33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS**
- 08 Alternative Fuels
- 03 Electric-Powered Systems
- 07 Emission Control
- 02 External Combustion Engines
- 05 Flywheel Propulsion
- 04 Hybrid Systems
- 01 Internal Combustion Engines
- 06 Vehicle Design Factors

**35 ARMS CONTROL**
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

**56 BIOMEDICAL SCIENCES, APPLIED STUDIES**
- 03 Chemicals Metabolism and Toxicology
- 04 Other Environmental Pollutant Effects
- 01 Radiation Effects
- 02 Thermal Effects

**55 BIOMEDICAL SCIENCES, BASIC STUDIES**
- 30 Agriculture and Food Technology
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology
- 04 Genetics
- 06 Medicine
- 05 Metabolism
- 07 Microbiology
- 08 Morphology
- 09 Pathology
- 10 Physiological Systems
- 20 Public Health

**40 CHEMISTRY**
- 01 Analytical and Separations Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry
- 04 Electrochemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry

**01 COAL AND COAL PRODUCTS**
- 05 By-Products
- 40 Combustion
- 09 Environmental Aspects
- 60 Health and Safety
- 70 Legislation and Regulations
- 50 Marketing and Economics
- 20 Mining
- 03 Preparation
- 04 Processing
- 06 Properties
- 10 Reserves and Exploration
- 30 Transport and Handling
- 08 Waste Management

**30 DIRECT ENERGY CONVERSION**
- 02 EHD Generators
- 05 Fuel Cells
- 01 MHD Generators
- 08 Miscellaneous Converters
- 04 Thermionic Converters
- 03 Thermoelectric Generators

**20 ELECTRIC POWER ENGINEERING**
- 02 Environmental Control Technology
- 01 Power Plants and Power Generation
- 03 Power Transmission and Distribution

**32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION**
- 01 Buildings
- 09 Education and Public Relations
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 02 Transportation

**29 ENERGY PLANNING AND POLICY**
- 10 Conservation
- 80 Consumption and Utilization
- 02 Economics and Sociology
- 60 Electric Power
- 01 Energy Analysis and Modeling
- 03 Environment, Health, and Safety
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 04 Natural Resources
- 06 Nuclear Energy
- 30 Policy, Legislation, and Regulation
- 05 Research, Development, Demonstration, and Commercialization
- 20 Supply, Demand, and Forecasting
- 07 Transport and Storage
- 90 Unconventional Sources and Power Generation
- 08 Waste Heat Utilization

**25 ENERGY STORAGE**
- 09 Batteries
- 04 Capacitor Banks
- 08 Chemical
- 02 Compressed Gas
- 05 Flywheels
- 07 Liquefied Gas
- 01 Magnetic
- 03 Pumped Hydro
- 06 Thermal

**42 ENGINEERING**
- 10 Combustion Systems
- 08 Electronic Circuits and Devices
- 02 Facilities and Equipment
- 04 Heat Transfer and Fluid Flow
- 03 Lasers
- 30 Marine Engineering
- 05 Materials Testing
- 40 Pollution Control Equipment
- 50 Power Cycles
- 20 Underground Engineering
- 09 Waste Processing Plants and Equipment

**52 ENVIRONMENTAL SCIENCES, AQUATIC**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

**50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

**51 ENVIRONMENTAL SCIENCES, TERRESTRIAL**
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

**53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES**
- 02 Assessment of Energy Technologies
- 01 Social and Economic Studies

**45 EXPLOSIONS AND EXPLOSIVES**
- 01 Chemical
- 03 Explosion Detection
- 02 Nuclear

**70 FUSION ENERGY**
- 02 Fusion Power Plant Technology
- 01 Plasma Research

**99 GENERAL AND MISCELLANEOUS**
- 05 Civilian Defense
- 03 Information Handling
- 04 Law
- 01 Management
- 02 Mathematics and Computers

**58 GEOSCIENCES**
- 04 Geochemistry
- 01 Geology and Hydrology
- 02 Geophysics
- 03 Mineralogy, Petrology, and Rock Mechanics
- 05 Oceanography

**15 GEOTHERMAL ENERGY**
- 07 By-Products
- 10 Direct Energy Utilization
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 02 Geology and Hydrology of Geothermal Systems
- 20 Geothermal Data and Theory
- 09 Geothermal Engineering
- 03 Geothermal Exploration and Exploration Technology
- 08 Geothermal Power Plants
- 04 Legal and Institutional Aspects
- 01 Resource Status and Assessment

**57 HEALTH AND SAFETY**

**13 HYDRO ENERGY**
- 05 Economics and Management
- 06 Environmental Aspects
- 03 Plant Design and Operation
- 07 Power-Conversion Systems
- 04 Regulations and Licensing
- 01 Resources and Availability
- 02 Site Geology and Meteorology

**08 HYDROGEN**
- 07 By-Products
- 09 Environmental Aspects
- 06 Industrial and Commercial Use
- 04 Marketing and Economics
- 01 Production
- 08 Properties
- 05 Safety
- 02 Storage
- 03 Transport

**44 INSTRUMENTATION**
- 03 Miscellaneous Instruments
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 01 Radiation Instrumentation
- 04 Well Logging Instrumentation

**07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY**
- 04 Economics
- 03 Isotopic Power Supplies
- 01 Physical Isotope Separation
- 02 Radiation Sources

**36 MATERIALS**
- 02 Ceramics, Cermets, and Refractories
- 01 Metals and Alloys
- 06 Other Materials

**03 NATURAL GAS**
- 09 Artificial Stimulation
- 40 Combustion
- 03 Drilling, Production, and Processing
- 08 Environmental Aspects
- 02 Geology and Exploration
- 05 Health and Safety
- 10 Legislation and Regulation
- 06 Marketing and Economics
- 04 Products and By-Products
- 30 Properties
- 01 Reserves
- 50 Storage
- 20 Transport, Pipelines, and Handling
- 07 Waste Management

**05 NUCLEAR FUELS**
- 30 Environmental Aspects
- 04 Feed Processing
- 07 Fuels Production and Properties
- 40 Health and Safety
- 60 Legislation and Regulations
- 10 Marketing, Economics, and By-Products
- 01 Reserves, Exploration, and Mining
- 50 Safeguards, Inspection, and Accountability
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 05 Uranium Enrichment
- 20 Waste Management

**21 NUCLEAR POWER PLANTS**
- 08 Economics
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 05 Power Reactors, Breeding
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 07 Regulation and Licensing

**22 NUCLEAR REACTOR TECHNOLOGY**
- 02 Components and Accessories
- 04 Control Systems
- 05 Environmental Aspects
- 03 Fuel Elements
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety
- 06 Research, Test, and Experimental Reactors
- 01 Theory and Calculation

**04 OIL SHALES AND TAR SANDS**
- 06 Direct Uses and By-Products
- 03 Drilling, Fracturing, and Mining
- 10 Environmental Aspects
- 07 Health and Safety
- 08 Marketing and Economics
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 20 Regulations
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 09 Waste Research and Management

**09 OTHER SYNTHETIC AND NATURAL FUELS**
- 02 Alcohol Fuels
- 06 Gaseous Waste Fuels
- 01 Hydrocarbon Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 05 Liquid Waste Fuels
- 04 Solid Waste and Wood Fuels

**43 PARTICLE ACCELERATORS**
- 03 Auxiliaries and Components
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 01 Design, Development, and Operation
- 04 Storage Rings

**02 PETROLEUM**
50 Combustion
03 Drilling and Production
09 Environmental Aspects
02 Geology and Exploration
06 Health and Safety
10 Legislation and Regulation
07 Marketing and Economics
04 Processing
05 Products and By-Products
30 Properties
01 Reserves
40 Storage
20 Transport, Pipelines, and Handling
08 Waste Management

**64 PHYSICS I**
01 Astrophysics and Cosmology
02 Atmospheric Physics
03 Atomic, Molecular, and Chemical Physics
04 Fluid Physics
50 High Energy Physics

**65 PHYSICS II**
60 Condensed Matter Physics
50 Medical Physics
10 Nuclear Physics
12-20 Nuclear Properties and Reactions
30 Nuclear Theory
40 Radiation and Shielding Physics
61 Superconductivity
70 Theoretical and Mathematical Physics

**14 SOLAR ENERGY**
03 Economics
04 Environmental, Legal, and Institutional Aspects
20 Heat Storage
08 Ocean Energy Systems
06 Photovoltaic Power Systems
01 Resources and Availability
10 Solar Collectors and Concentrators
05 Solar Energy Conversion
07 Solar Thermal Power Systems
09 Solar Thermal Utilization

**16 TIDAL AND WAVE POWER**
04 Economics
05 Environmental Aspects
03 Regulations
07 Tidal Power Plants
08 Wave Energy Converters

**17 WIND ENERGY**
01 Availability (Climatology)
04 Economics
05 Environmental Aspects
03 Regulations
06 Wind Energy Engineering

**CORPORATE AUTHOR INDEX**

**PERSONAL AUTHOR INDEX**

**SUBJECT INDEX**

**CONTRACT NUMBER INDEX**

**REPORT NUMBER INDEX**

**FILE NUMBER CORRELATION**

# ENERGY RESEARCH ABSTRACTS

## 01 COAL AND COAL PRODUCTS

### 0103 Preparation

*REFER ALSO TO CITATION(S) 36269, 36293, 36336, 36360, 36363, 36364*

**36228 (CONF-851047—2) Fine grinding and flotation to desulfurize coal.** Miller, K.J. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011813.

From International conference on alternative technologies for utilization of high sulphur coal; Columbus, OH, USA (13 Oct 1985).

Because of the growing need to develop new technology for producing superior quality coals to replace oil and natural gas, the US Department of Energy's Coal Preparation Division is looking at fine grinding and multistage flotation processes to maximize the liberation and removal of sulfur-bearing and ash-forming mineral matter from coal. The beneficiation of micronized coal by froth flotation has long been considered unsatisfactory because of poor product quality and/or poor recovery. However, our current work suggests that superclean products of high yield can be obtained by a combination of coarse coal cleaning or rougher flotation, followed by wet grinding and recleaning by second-stage coal flotation. For example, by a combination of rougher flotation, wet grinding of the rougher concentrate, and two-stage flotation of the wet-ground product, an Upper Freeport bed coal sample was cleaned from 26% ash and 1.1% pyritic sulfur to 4.5% ash and 0.1% pyritic sulfur. 6 refs.

**36229 (CONF-860340—17) Sulfur reduction from coal through physical beneficiation.** Deurbrouck, A.W. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011811.

From 115. American Institute of Mining, Metallurgical and Petroleum Engineers annual meeting; New Orleans, LA, USA (2 Mar 1986).

From 1970 to 1978, between 43% and 47% of the coal shipped to electric utilities was washed. This percentage remained virtually constant over the 8-year period, even though the total tonnage of coal consumed by the electric utilities varied significantly. Apparently, the utility industries' buying patterns remained about the same over these years with regard to product quality. This pattern appears to have changed sometime between 1978 and 1983, when a dramatic move to coal washing took place in the major eastern and midwestern coal-producing states. The application of coal beneficiation as a first step in sulfur reduction is logical and cost effective. Exciting new beneficiation techniques are being developed in response to the need to further desulfurize and demineralize coals. It is reasonable to anticipate that coal beneficiation will continue to gain recognition as the technology of choice to aid in providing environmentally acceptable fuels, and thus will encourage greater utilization of coal. 4 refs., 2 figs., 8 tabs.

**36230 (CONF-860801—1) A humic acid binder for pelletizing of fine coal.** Wen, W.W.; Bergman, P.D.; Deurbrouck, A.W. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011818.

From 10. international coal preparation congress; Edmonton, Alberta, Canada (31 Aug 1986).

This paper describes a new coal pelletization process that utilizes a coal-derived binder consisting of a water-soluble colloidal system of humic acids dispersed in an ammonium hydroxide solution. Fine-coal pellets produced by this process were subjected to various physical-strength and weather-resistance tests. These tests showed that the humic acid binder produces strong and durable bituminous coal pellets equal or superior to those produced with other binders. A preliminary cost analysis indicates that the humic acid binder can be produced for less than one half the cost of an asphalt binder. 9 refs.

**36231 (CONF-860826—14) FY 86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center.** Killmeyer, R.P. (USDOE Pittsburgh Energy Technology Center, PA). Aug 1986. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011805.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Over the last few years, the objective of the DOE Office of Fossil Energy coal preparation program has been, and still is, to develop coal preparation technology that can reduce the ash and sulfur contents of raw coal so that the product can be used directly as a clean fuel that could replace oil and natural gas and reduce environmental emissions. Beneficiation to superclean levels requires near-complete liberation of coal from its associated impurities, and this, in turn, requires comminution to ultrafine sizes (<74 microns). Thus the focus of each project in the coal preparation program is on the potential problems presented by beneficiating ultrafine particles as opposed to conventional size particles. This paper will highlight six projects currently being conducted in PETC's Coal Preparation Division: centrifugal float-sink, automated petrography, heavy-liquid cycloning, dry electrostatic separation, froth flotation, and fundamental coal surface science. The objective and background of each project will be discussed, along with recent progress and future direction.

**36232 (CONF-861063—7) Effect of coal cleaning on the combustion environment-materials interaction.** Natesan, K.; Holve, D.J. (Argonne National Lab., IL (USA); INSITEC, Danville, CA (USA)). Sep 1986. Contract W-31109-ENG-38. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004853.

From American Society of Metals materials week; Lake Buena Vista, FL, USA (6 Oct 1986).

Cleaning of coals by physical and chemical methods and micronizing are being considered to improve the combustion efficiency and increase the heating value of coal. From the component materials viewpoint, the environment established by combustion of cleaned coal and its interactions with materials are of interest. For this purpose, several modes of materials degradation such as deposition/fouling, corrosion, and erosion relevant to coal-fired systems are discussed and the influence of physical and chemical properties of coal and mineral matter on the degradation mechanisms are presented. Combustion characteristics of cleaned coals are examined and their effects on fly ash formation, deposition processes, alkali and sulfur attack of materials, and erosive wear of materials are analyzed. 25 refs., 13 figs.

**36233 (CONF-861131—4) Heavy-liquid cycloning of fine-size coal.** Maronde, C.P.; Killmeyer, R.P. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011821.

From 6. intersociety cryogenics symposium; Miami Beach, FL, USA (2 Nov 1986).

The Pittsburgh Energy Technology Center of the US DOE recently conducted an in-house research study evaluating the use of heavy liquids in a cyclone to beneficiate fine-size coal. A closed-loop cyclone circuit was designed, constructed, and fitted with a 5-cm cyclone having a nominal 2-tph throughput. Testing incorporated a 30-test experimental matrix to evaluate the effects of feed inlet

pressure, feed solids concentration, feed moisture content, and Aerosol OT-100 surfactant addition on separation efficiency when using Freon-113 as the separating liquid to beneficiate a 500 micron x 0 feed coal. Results of this work indicated that sharp separations can indeed be achieved on fine-size coal using a Freon liquid as the separating medium, with ash and pyritic sulfur reductions of up to 63% and 78%, respectively. Of the four operating parameters evaluated, feed moisture content had the greatest effect on the quality of separation. In particular, a 5% feed moisture produced the 7 best separations out of the 30 tests run. Results also indicated that the primary difference in quality of separation among the tests can be attributed to the quality of separation of the 37 micron x 0 fraction. Also, in a brief in-house comparison, heavy-liquid cycloning produced separations superior to three other fine-coal-cleaning technologies. 3 refs., 2 figs., 9 tabs.

36234 **(CONF-8006116—3) Surface chemical problems in coal flotation.** Taylor, S.R.; Miller, K.J.; Deurbrouck, A.W. (USDOE Pittsburgh Energy Technology Center, PA). 1980. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011816.

From Conference on chemistry and physics of coal utilization; Morgantown, WV, USA (4 Jun 1980).

As the use of coal increases and more fine material is produced by mining and processing, the need for improved methods of coal beneficiation increases. While flotation techniques can help meet these needs, the technique is beset with many problems. These problems involve surface chemical and interfacial properties of the coal-mineral-water slurry systems used in coal flotation. The problems associated with coal flotation include non-selectivity, inefficient reagent utilization, and excessive variability of results. These problems can be broadly classified as a lack of predictability. The present knowledge of coal flotation is not sufficient, in terms of surface chemical parameters, to allow prediction of the flotation response of a given coal. In this paper, some of the surface chemical properties of coal and coal minerals that need to be defined are discussed in terms of the problems noted above and their impact on coal cleaning. 6 refs., 9 figs., 5 tabs.

36235 **(DOE/FE—0083) America's clean coal commitment.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Feb 1987. 103p. H; 1; GPO Dep. File Number DE87010690.

America's Clean Coal Commitment illustrates the national investment being made, particularly by the power generating industry, to improve the quality of the nation's air while increasing the use of America's most abundant fossil energy resource, coal. This investment takes on two forms: (1) the financial response of the utility industry to the requirements of the 1970 Clean Air Act, and (2) the recent expansion of efforts across the nation to develop and demonstrate a new generation of innovative clean coal technologies in flue gas scrubbing, coal cleaning, and coal switching.

36236 **(DOE/PC/81210—T15) Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87.** Yang, D.C. (Michigan Technological Univ., Houghton (USA). Inst. of Materials Processing). 15 Jul 1987. Contract AC22-85PC81210. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012096.

Research continued to test various flotation circuit configurations using the two selected coals - Pittsburgh and Lower Kittanning. We have successfully conducted the tests in the laboratory two-stage tube flotation system for both coals in open circuits. The two proposed two-stage flowsheets which are more likely to be used in the pilot test campaign include Flowsheet "A" which denotes a circuit where the first stage concentrate is reground and refloated in the second stage to produce the final concentrate, and Flowsheet "B" that represents the alternative flowsheet in which the final concentrate is produced at the first stage and the tailings are reground and refloated to recover additional value in the second stage. In either case, the middling product can be recirculated back to the first stage to improve overall cleaning efficiency. Even though a clean coal of <2% ash can be produced with >80% Btu recovery in one-stage tube flotation for both coals, the two-stage system might be more economical in view of the cost reduction in grinding as well as superior product quality and improved recovery of the clean coal with either an open or closed circuit. The preliminary results indicate that the previous findings using the batch grind scheme can be duplicated in a continuous two-stage open system with some modification of the reagent addition especially for Flowsheet "A". When it was closed, however, the circuit became quite sensitive to operational fluctuations possibly due to froth segregation in a relatively small sump in the laboratory system. As expected, tests on Flowsheet "B" had fewer problems. 4 figs., 3 tabs.

36237 **(DOE/PC/90536—T3) Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987.** Hu, W.; Rajamani, K. (Utah Univ., Salt Lake City (USA)). 1987. Contract FG22-86PC90536. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012108.

This project is concerned with the development of better ways for production of low-ash and low-sulfur coal. The proposed autogenous process takes advantage of the self-differentiating surface properties between coal, ash, and sulfur-containing minerals. The equal-floatability principle is made use of in the roughing stage, using the reagentized coarse particles as carrier (self-generated) to carry ultrafine particles. The extent of desulfurization and deashing of conventional physical separation processes is limited by the presence of ultrafine particles and liberation of pyrite and ash from the coal matrix. These two factors oppose each other. However, the autogenous carrier proposed here overcomes this problem and aims to produce clean coal from samples containing ultrafine particles. Using a principle termed equal floatability, the ground coal samples are separated into fractions of different floatability in ionic, frother-only, frother + collector, and frother + collector + activator media. The froth thus obtained contains adsorbed reagents. The reagentized coarse coal thus generated is then used as carrier for the flotation of ultrafine coal samples. In addition, a scheme called differential-rate cleaning is also used to further enhance the quality of the final product.

36238 **(DOE/PC/90538—3) Use of basic nitrogen to chemically clean coal: Quarterly report No. 3 for the period March 16, 1987 to June 15, 1987.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 19 Jun 1987. Contract FG22-86PC90538. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010774.

The effect of reaction temperature and coal moisture content on sulfur removal from a North Dakota lignite, a Wyoming subbituminous coal and a Kentucky bituminous coal was established. During the second quarter of this project, the effect of moisture content on the extent of sulfur removal from the coals studied was found to be complicated by the fact that while the equilibrium moisture content of the undried lignite and subbituminous coal was approximately 20 wt %, the equilibrium moisture content of the undried bituminous coal was only 2 wt %. Therefore the experimental procedure was changed in this quarter. All coals were first air dried to a moisture level below 1 wt %. The coals were then desulfurized under either a hydrogen or carbon monoxide atmosphere, with or without water addition, using relatively mild coal liquefaction reaction conditions. The results obtained from these microautoclave desulfurization experiments suggest that sulfur is more readily removed from the subbituminous coal than from either bituminous coal or the lignite. Increasing reaction temperature from 600° to 700°F had a significant effect on increasing the extent of the desulfurization reaction. As pyridine conversions have been used to indicate the susceptibility of deashing coal liquefaction reaction product using critical solvent deashing processes, pyridine conversions of reaction products from this work were also measured. Increasing reaction temperatures increased pyridine conversion. However, it was found that the distillable solvents used in this work may not be the most effective solvents for converting coal to pyridine soluble product.

**36239 (DOE/PC/91272—T11) Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987.** Hippo, E.J.; Sarvela, D.P.; Murdie, N. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). May 1987. Contract FC22-86PC91272. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010424.

Present New Source Performance Standards and the prospect of new acid rain legislation at the federal level require that methods be developed to remove substantial portions of sulfur from Illinois Basin coals. This report describes an innovative approach to coal desulfurization. In this approach, quaternary ammonium salts are employed as catalysts to swell coal. The process is designed to address three basic problems which exist in Illinois Basin coals. First, the pyrite in these coals is at a high level and is very finely dispersed. Therefore, the pyrite particles cannot be liberated by conventional coal cleaning techniques. Second, the porosity of these coals is routinely high but is closed to many reactants because of the lack of feeder and transitional pore structure. Third, the high organic sulfur levels require that some sort of chemical desulfurization occur before most Illinois coals meet NSPS standards. The swelling of coals by quaternary salt results in the liberation of the smallest pyrite and inertinite particles of the coal. Furthermore, cracks occur in the coal particle after swelling. These cracks are associated with the larger size pyrite material embedded in -60 mesh ground coal. Only small amounts of quaternary salt are exchanged on the coal. In some cases, a small amount of exchange results in pore enlargement. Under other conditions, chemical desulfurization of organic sulfur is observed. Relationships between the conditions of exchange, mineral and inertinite liberation, pore enlargement, and coal desulfurization are discussed. The results suggest that: (1) quaternary salts may be used to interrupt oxidation degradation of the coal; (2) coals might be liquified employing specific quaternary salt treatments; and (3) under specific conditions, organic sulfur may be attacked selectively. 3 refs., 22 figs., 30 tabs.

## 0104 Processing

*REFER ALSO TO CITATION(S) 36228, 36238, 36239, 36295, 36296, 36300, 36301, 36301, 36302, 36303, 36304, 36308, 36309, 36310, 36324, 36327, 36335, 36336, 36348, 36349, 36367, 36367, 36460, 36577, 36751, 37011, 37293*

**36240 (CONF-870659—2) Development of iron aluminides for coal gasification systems.** McKamey, C.G.; Liu, C.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011111.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of the present study is to develop $Fe_3Al$-based aluminides with an optimum combination of strength, ductility, and corrosion resistance for use as hot components in advanced fossil energy conversion systems. Currently, heat-resistant alloys are either nickel-based or high-nickel-content steels containing a delicate balance of one or more of the strategic elements such as chromium, cobalt, and tungsten to produce the desired properties. The alloys under investigation in this study (iron aluminides) do not contain significant amounts of strategic elements, and they also have properties that make them attractive for fossil energy applications. Because of their ability to form a protective aluminum oxide film at very low oxygen partial pressures, iron aluminides near the $Fe_3Al$ composition exhibit excellent corrosion resistance (including resistance to sulfidation) at high-temperatures in such environments. Other advantages are high strength at room temperature, lower density, and lower cost. Although the usefulness of the binary alloys is limited by low room-temperature ductility (1 to 2%) and poor hot strength above 550°C, studies of several advanced (with minor alloy additions) iron-aluminum alloys based on the $Fe_3Al$ composition indicate dramatic improvements in properties (McKamey and Liu 1986, McKamey et al. 1987). This report describes recent progress in characterizing the effects of additions of other elements (<10 at. %) on the metallurgical and mechanical properties of our selected base alloy, Fe-28 at. % Al. 2 refs., 1 fig., 1 tab.

**36241 (DOE/MC/21097—2338) Sulfur recovery from hot coal gas desulfurization processes: Final report.** O'Hara, J.B.; Chow, T.K.; Findley, J.E. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Apr 1987. Contract AC21-84MC21097. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87006477.

This report summarizes work to define preferred procedures and economics for producing elemental sulfur from the sulfur dioxide ($SO_2$) contained in the Hot Gas Desulfurizer System Regenerator offgas. The $SO_2$ concentration in the regenerator offgas can range from 1.5 to 5.0 volume percent. Three types of processing units were considered for treating the regenerator offgas, including (1) $SO_2$ concentration/purification (C/P), (2) $SO_2$ reduction/sulfur production (R/P), and (3) tail gas treatment to ensure meeting environmental emission standards. The $SO_2$ C/P unit will significantly increase the $SO_2$ concentration and reject impurities. Eleven $SO_2$ C/P, 6 R/P and 5 tail gas technologies were investigated, offering 300-plus possible combinations for complexes using the three cited process functions. Each of the 11 candidate configurations was independently rated by three professional designers/evaluators and the assigned points totaled. Based on these results, the recommended configuration for experimental testing consisted of a Wellman-Lord $SO_2$ C/P unit, an Augmented Claus unit and tail gas treatment by thermal incineration of the Claus tail gas followed by its recycle to the Wellman-Lord unit. The alternative BSRP configuration was also judged to have high potential. A BSRP plant consists of a Beavon Sulfur Removal (BSR) unit to convert all sulfur compounds to hydrogen sulfide ($H_2S$) followed by a Stretford unit to convert the $H_2S$ to elemental sulfur. The Augmented Claus and BSRP have been judged to be preferred processes and projected processing costs for these technologies have been estimated. Further process optimization promises improved economics. 9 refs., 22 figs., 34 tabs.

**36242 (DOE/METC—86/6069, pp 1-4) Opening remarks: instrumentation, components, and materials contractors meeting.** Pitrolo, A.A. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The nine projects selected for financing under DOE's Clean Coal Technology Program are listed. The importance of instrumentation, components, and materials research to the scale-up of these fossil energy technologies is discussed. Two processes are highlighted: direct coal-fired gas turbines and liquids from coal and oil shale.

**36243 (DOE/METC—86/6069, pp 77-89) Advanced research in instrumentation and control technology: capacitance flowmeter.** Bobis, J.P. (Argonne National Lab., IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The purpose of this task is to develop and apply instruments to measure the solid feed rate in coal gasification plant gas-solid feedlines, interstage lines, and recycling lines. To date, one of the most promising techniques for mass flow measurements in a solid/gas flow stream is the use of the nonintrusive capacitive sensor. The performance of the capacitive flowmeter (CF) with an improved electrode geometry has been assessed experimentally in a gas-entrained 1000 $\mu$m glass bead flow stream at the Argonne National Laboratory Solid/Gas Flow Test Facility. The CF measured the solid volume fraction and particle velocity and the results were compared with time-of-flight measurements of short-lived radioactive particles. 21 references, 9 figures.

**36244 (DOE/METC—86/6069, pp 90-99) Advanced research in instrumentation and control technology: multiphase flow studies.** Doss, E.D.; Strinivasan, M.G. (Argonne National Lab., IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of these studies is to develop and analytical models of the physical phenomena involved in the flow of solid/gas

mixtures in ducts, and to verify the developed models through experiments in the Argonne National Laboratory's Solid/Gas Flow Test Facility (SGFTF). Analytical models thus verified would be used for developing nonintrusive flow instruments. A one-dimensional, two-phase, multispecies computational model has been developed for solid/gas flows in a horizontal duct that includes expressions for particle-to-particle and particle-to-wall interaction terms. The model and experimental program are described. 8 references, 3 figures, 3 tables.

36245 (DOE/METC—86/6069, pp 146-155) **Coal slurry letdown device.** Collins, E.R.; Rohatgi, N.K. (Jet Propulsion Lab., Pasadena, CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AI21-81MC16512.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

A problem common to most coal gasification and liquefaction processes is the lack of reliable, long-life pressure letdown systems. Such systems must accommodate three-phase, coal-liquid-gas mixtures at temperatures up to 1600 F and pressures up to 3000 psia. Commercial development of these advanced fuel processes requires reliable, low maintenance letdown systems. The standard approach to pressure letdown is to throttle the flow by reducing the flow area in a throated control valve. Unfortunately, high velocities in the valve throat combine with the abrasive solids content of typical coal-derived slurries resulting in excessive valve wear, lack of controllability, and short lifetimes. Attempts to use advanced materials which are more durable under such conditions have met with limited success. An alternative approach, developed at the Jet Propulsion Laboratory, California Institute of Technology (JPL), is to reduce the throat velocities by using the concept of the porous plug. In this technique the pressure is reduced by means of a throttling process through a series of successive perforated plates while maintaining low velocities throughout the device to minimize the impact of erosion. The major results obtained to date in the JPL pressure letdown system (PLS) project are presented in this paper. The four major tasks include: a) development and testing of the PLS; b) experimental erosion studies and analysis; c) control of the PLS; and d) development of an ash letdown unit based on the PLS technology. In addition, a proposed PLS Technology Transfer effort is considered briefly. 3 references, 6 figures.

36246 (DOE/METC—86/6069, pp 156-164) **Slurry valve development.** Hauserman, W.B. (Univ. of North Dakota, Grand Forks). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC21-85MC22109.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

An objective of this project is to provide minimal experimental evidence of the feasibility of three novel flow control devices, described herein for use in highly erosive, high pressure slurry applications, primarily as pressure let-down valves, all using cheap, sacrificial materials to take all the erosive wear at the points of maximum flow constriction. A further objective is to demonstrate a technique of accelerated erosion of critical components simulated in soft plastic. Pursuant to the secondary objective of this project, the UNDERC slurry erosion test loop was developed. The Micromotion mass flow meter and the Sandpiper diaphragm pump have proven virtually impervious to erosion damage, even with the highly erosive slurry of -270 mesh (53 microns) quartz in water. The specific valve design concepts tested are described, and results are discussed. 9 references, 6 figures.

36247 (DOE/METC—86/6069, pp 165-174) **Alternative flow control nozzles: energy dissipation of highly erosive fluids.** Maddox, P. (Biphase Energy Systems, Santa Monica, CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC21-86MC22250.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of this study is to perform proof-of-concept testing of an innovative flow-control device in a laboratory flow loop utilizing an erosive multiphase fluid. Performance results are to be compared to a conventional globe valve tested under the same conditions. This device is a potential alternative to existing synfuel letdown valves, which suffer from rapid erosion, loss of control, and high cost. The initial project task evaluated coal-fluid pressure letdown steams with respect to isentropic expansion velocities so that representative test conditions could be selected within the constraints imposed by available laboratory equipment and working fluids. The next phase involved design and fabrication of the Flow Control Device (FCD), which consists of three pairs of opposed nozzles mounted in a receiver/separator with a mist eliminator pad. The nozzle contour was designed for application to multiphase flow streams. This program is based on the multiphase flow streams. A test loop was then designed and assembled. The FCD and test loop are described and results are discussed. 5 references, 5 figures.

36248 (DOE/METC—86/6069, pp 175-187) **Fluid friction control valve.** Novack, M.E. (General Applied Science Labs., Ronkonkoma, NY). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC21-85MC22249.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of this project is to design, construct, and perform laboratory bench-scale evaluation tests on an innovative fluid friction control valve (FFCV) to determine its suitability for coal conversion plant pressure letdown applications. The tests are being conducted using a proof-of-concept bench-scale test loop, with three phase mixtures comprised of solids-water-steam, to simulate conversion plant conditions to prove out the valve concepts established. The FFCV and test loop are described. Results from erosion tests and pressure control tests are discussed. A computer code has been developed to predict pressure drop characteristics of the FFCV and can be used to design a FFCV for a specific slurry-vapor or solids-vapor mixture. 2 references, 10 figures.

36249 (DOE/METC—86/6069, pp 188-195) **Reduced girth seam weldments for heavy-walled vessels.** Horacek, D.R.; Peters, S.W. (CBI Na-Con, Inc., Oak Brook, IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of this contract is to evaluate by design, analysis and testing three different configurations for the reduced thickness area. The detail that proves to be the most technically merited will then be evaluated to determine the vessel cost savings for implementing the design details. Construction schedule savings will also be estimated and resulting finance cost savings for a gasification plant will be estimated. A qualitative estimate for the overall plant cost savings for a plant using larger vessels (as made practical by this research) and therefore, fewer process trains will be made. The specific objectives of this research are: 1) Demonstrate that a local reduction in thickness for a heavy-wall vessel can be designed to meet the rules of ASME. 2) By analysis and testing determine which of three different configurations provides a pressure-load capacity most like that of a vessel without areas of reduced thickness. Develop cost estimates for vessel savings and overall plant savings as a result of this concept. 3) Provide information to the public domain so that the component enhancement developed by this research can be used in planning future coal gasification projects.

36250 (DOE/METC—86/6069, pp 196-206) **Electroslag component casting.** Sikka, V.K. (Oak Ridge National Lab., TN). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC05-84OR21400.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

This project is directed toward the development of electroslag casting (ESC) technology for use in coal conversion components such as valve bodies, pump housings, and pipe fittings. The aim is also to develop a sufficient data base to permit electroslag casting to become an ASME Code-accepted process. It is also intended to transfer the ESC process technology private industry. Results to date are described. 10 references, 7 figures, 3 tables.

36251 (DOE/METC—86/6069, pp 207-217) **Development of iron aluminides for gasification systems.** McKamey, C.G.; Liu, C.T. (Oak Ridge National Lab., TN). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC05-84OR21400.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Iron aluminides based on $Fe_3Al$ are ordered intermetallic alloys which have good oxidation and corrosion resistance, low material cost, and which conserve strategic materials such as chromium. They also have a lower density than stainless steels and therefore a better strength-to-weight ratio. However, limited ductility at ambient temperatures and a sharp drop in strength above 600 C are major disadvantages to their use as structural materials. The goal of the present study is to develop aluminide alloys based on $Fe_3Al$ with an optimum combination of strength, ductility, and corrosion resistance for use as hot components in advanced fossil energy conversion systems. Alloys with compositions of Fe-24, 25, 26, 27, 28, and 30 at. % Al, each containing 0.5 wt % $TiB_2$ added for grain refinement, were prepared by arc melting under argon and drop casting into water-cooled copper molds. Tensile properties, oxidation, sulfidation, and welding tests are described. Results are discussed.

36252 (DOE/METC—86/6069, pp 218-228) **Protective coatings and claddings: applications/evaluation.** Baxter, D.J. (Argonne National Lab., IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of the project is to develop corrosion-resistant coatings for the protection of low-alloy steels exposed in downstream waste heat recovery systems of coal gasifiers. A specification will be formulated for boiler-grade steels and established coating procedures that will serve as a guide for future designers of heat recovery systems. The specification will cover not only general properties of coatings, but means by which coated components can be fabricated and repaired. A specially designed corrosion test rig was built so that tubular specimens could be exposed to typical coal gasifier product gas mixtures on one surface while being cooled on the other surface, thus enabling heat recovery system conditions to be closely simulated. Coatings were applied by chromizing, aluminizing, or simultaneously aluminizing/chromizing pack-diffusion processes to 2 1/4Cr-1Mo and carbon steels. These processes were chosen because of their suitability to coat large or complex-shape components of the type used in waste heat recovery systems. Results from corrosion testing are discussed. 7 references, 3 figures, 2 tables.

36253 (DOE/METC—86/6069, pp 229-243) **High-temperature rotating shaft seal.** Shapiro, W.; Heshmat, H. (Mechanical Technology Inc., Latham, NY). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of this study is to develop and evaluate rotating shaft seals for operation over long periods of time under extreme environmental conditions of high pressure (up to 10 MPa or 1500 psig), high temperature (430 to 816 C, and high levels of particulate contamination (50,000 to 100,000 ppm) typical of gasification processes, without external cooling or flushing. To determine interfacial characteristics, three principal types of seal configurations will be evaluated: compliant surface, compliant mount; rigid surface, compliant mounts; and rigid surface, rigid mount. materials are described. The first phase was to develop a commercialization plan which outlines potential uses and impact of developed seals and a sequence for making seals into commercial products. This plant is discussed. 13 figures, 6 figures, 3 tables.

36254 (DOE/METC—86/6069, pp 244-253) **Zirconia cell oxygen source.** Suitor, J.W.; Schroeder, J.E.; Berdahl, C.M. (Jet Propulsion Lab., Pasadena, CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AI21-84MC21032.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The oxygen separation ability of zirconia is rooted in the oxygen ion conduction capability of the material. The driving force of this transport is the potential applied across the membrane by a dc power supply. This study will evaluate, design, test, and transfer to an industrial partner a 100-liter/min oxygen production unit based on a zirconia module for oxygen separation from air. This paper discusses cell design, materials fabrication, alternative materials, modelling studies, and an economic assessment. 1 reference, 8 figures.

36255 (DOE/METC—86/6069, pp 267-268) **Coal slurry letdown device.** Marner, W.J. (Jet Propulsion Lab., Pasadena). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

A problem common to most coal gasification and liquefaction processes is the lack of reliable, long-life pressure letdown systems. Such systems must accommodate three-phase coal/ash-liquid-gas mixtures and withstand temperatures up to 1600 F and pressures to 3000 psi. In such environments high velocities in conventional control valves combined with abrasive solids result in excessive valve wear, lack of controllability, and short lifetimes. An alternative approach is the quasi-porous plug (QPP) letdown device which the pressure is reduced through a series of successive stages while maintaining a low velocity through each stage to minimize erosion. The major objectives of this effort include: (1) develop a pressure letdown system to the point of demonstrating feasibility and providing data to design pressure letdown systems, (2) determine the threshold parameters for minimum erosion in three-phase flow, (3) develop a controllable letdown device using a fluidic vortex control element, and (4) determine the suitability of the letdown device as an ash letdown unit. Two porous plug devices (8.0-inch and 3.5-inch diameter) were designed and successfully tested using air, steam-water, and diesel fuel-coal-pentane as test fluids. Based on these results, single-, two-, and multi-phase flow models were developed to design QPP letdown devices. Erosion studies were carried out in a bench-scale unit using sand-air and sand-air-water as test fluids to establish the threshold erosion parameters in multi-phase flow situations. A fluidic vortex control device was developed and tested using water, diesel fuel, and air-water as test fluids.

36256 (DOE/METC—86/6069, pp 269) **Zirconia tape casting.** Suitor, J.W.; Schroeder, J.E.; Berdahl, C.M. (Jet Propulsion Lab., Pasadena, CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AI21-84MC21032.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The development of alternate sources of oxygen other than from air liquefaction has been identified as a significant research need for the continued development of coal gasification. Air separation using a zirconia solid electrolyte membrane is one possible alternate source of oxygen. The objective of this multiyear effort is the development, fabrication, and testing of a zirconia oxygen production module capable of delivering approximately 1 ton/hour of oxygen. The oxygen separation capability of the zirconia membrane is derived from its ability to function as an electrodialysis membrane and selectively remove oxygen from gas mixtures containing oxygen. The operation of the zirconia oxygen separator is similar to the high-temperature solid electrolyte fuel cells. The different requirements for the two systems are substantial, requiring developmental work on the oxygen separators. A key part of the development of a zirconia oxygen separation cell is the ability to manufacture cells that consume little power. The principal criteria for low power consumption is thin zirconia electrolyte (less than 100 microns). The best method to accomplish this is by tape casting. Tape casting permits the fabrication of thin, dense ceramic sheets of the desired properties to use in the zirconia oxygen cell. Thicker, porous ceramic electrodes can also be fabricated by this method.

36257 (DOE/METC—86/6069, pp 273-274) **Gasification island concept systems.** Bajura, R.A.; Berkshire, L.H.; Craig, K.R.; Regenhardt, P.A.; Stone, K.R. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The technical feasibility of using integrated gasification combined-cycle systems for electric power production is currently being demonstrated at commercial scale (100 MWe) under utility operating conditions. The Morgantown Energy Technology center is assessing the performance and economic incentives for second-generation gasification/power production systems, gasification island concept systems, which build on the technology base of first-generation systems. The gasification island portion of the system encompasses all the processing steps required to convert coal into a clean fuel gas. Gasification island concept systems use hot gas cleanup processes, either internal or external to the gasifier, to remove contaminants from the low-Btu fuel gas produced by fixed- or fluid-bed coal gasifiers. The solids handling, gasification, and gas cleanup processes are factory-fabricated modules designed to couple with specific gas turbine systems. By using air-blown gasification systems (which consume less auxiliary power than oxygen-blown systems), hot gas cleanup, innovative gas treatment schemes, and high-efficiency gas turbine designs, the thermal efficiency of gasification island concept systems is projected to be higher than first-generation systems. Also, because of standardized designs and less complex process configurations, the engineering and equipment costs for gasification island concept systems are projected to be significantly lower, particularly for new capacity additions or life extension modifications in the 50 to 100 MWe range. The results of gasification island concept system studies and the implications of some of the Department of Energy-sponsored research programs being conducted in support of this concept are summarized.

36258 (DOE/METC—86/6069, pp 275) **Process control methodologies for advanced fossil energy process research.** Lawson, L.O. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective of process control studies is to investigate methodologies which enhance process data acquisition and control systems development leading to improved fossil energy processes. The computer-based enhancements being performed include two subjects: (1) the use of an Expert System for performing reasoning functions based on a knowledge base of process rules in conjunction with acquisition of process data and (2) the use of a computer algorithm for identifying models (System Identification) of the dynamic process mechanisms as determined from the time-sampled data of the process variables. The Expert System work involved interfacing the computer hardware with the data acquisition and control system, as well as linking the data acquisition and control software with the process knowledge base and inference software. The process rules are formulated to acquire and test process data and to direct control actions through the control system to the process actuators. The gas flow metering system of a Downhole Reservoir Tool (DRT) being developed at METC is the target system. The SI work has proceeded from a computer program written as the result of an earlier research contract for METC. Modifications were made to this program based on original theoretical work done for NASA. A procedure for validating the performance of the SI program was conducted and multivariable models were calculated for a gasification component process. The documented source code is written in Fortran and can be modified for specific applications in identifying dynamic system models from sets of process data. This program is a valuable tool, and plans are to incorporate it into medium-scale real-time data acquisition and control systems to provide adaptive control tuning.

36259 (DOE/METC—86/6069, pp 279) **High-temperature desulfurization of coal gas for gas turbine and fuel cell application.** Grindley, T. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Hot gas desulfurization utilizing zinc ferrite sorvents has high potential for gasifier combined-cycle and molten carbonate fuel cell types of application. METC is conducting a combined laboratory and gasifier sidestream test program to investigate novel sorbents and sorbent regeneration conditions. A 2-inch diameter fixed-bed laboratory unit is utilized for screening tests while a 6-inch diameter fixed-bed unit is utilized for sidestream testing utilizing gas from a fluidized-bed gasifier. Results from these programs generally demonstrate that: (1) sorbent reactivity increased up to 1200 F beyond which sintering may occur, (2) gas stream CO to ($CO + CO_2$) ratios must be controlled to avoid wustite formation, (3) residual sulfate is rapidly decomposed exothermally in the initial stages of absorption, and (4) sorbent durability can be enhanced by a number of additives such as bentonite.

36260 **(DOE/PC/60038—T6) Thermodynamics of molecular interactions in coal liquids: Progress report for the period July-December 1986.** Eatough, D.J.; Hansen, L.D.; Christensen, J.J.; Lewis, E.A. (Brigham Young Univ., Provo, UT (USA)). 1986. Contract FG22-83PC60038. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011691.

The objects of this study were to determine the thermodynamics associated with the interactions among the components of a model coal liquid by calorimetric techniques, to determine the vapor-liquid equilibria of mixtures of the model compounds and, based on these thermodynamic data, to develop new techniques for the prediction of vapor-liquid equilibria in coal liquids. Specifically, analyses of the isoperibol titration calorimetric data obtained at 25°C in tetralin solvent for the quinoline - m-cresol - aniline system has been completed; analyses of the heat of mixing data obtained at 25, 100, 200 and 300°C for the system m-cresol - quinoline - aniline - tetraline has been completed; analyses of the heat of mixing data for the m-cresol - furan and m-cresol - tetrahydroquinoline data have begun. A thermodynamic model for the interactions occurring in the system m-cresol - quinoline - aniline - tetralin has been completed. We have shown that the heat capacity of lower-, middle-, and high-boiling distillates can all be described using a combination of the Watson-Nelson correlation equation and linear corrections for molecular interactions in the coal liquid using the thermodynamic data we have obtained for the quinoline - m-cresol - tetralin and quinoline - m-cresol - decane systems. The data indicate that the effect of the interactions on the heat capacity can be described by linear corrections to the Watson-Nelson equation using the concentrations of basic nitrogen and phenolic compounds in the distillate fractions.

36261 (DOE/PC/60054—T13, pp 1-42) **Modeling of Wilsonville Integrated Two-stage Liquefaction (ITSL) process.** Feb 1987. NTIS, PC A11/MF A01. File Number DE87008403.

In Coal liquefaction: Investigation of reactor performances, role of catalysts and PCT properties: Final report.

Direct coal liquefaction involves the production of liquid fuels by increasing the hydrogen to carbon ratio and simultaneously removing the heteroatoms (N, S and O) and mineral matter from coal. Conventional liquefaction processes which include SRC-I and SRC-II (Solvent Refined Coal), H-Coal and EDS (Exxon Donor Solvent) are single stage processes, which considerably reduces process flexibility in terms of product quality and hydrogen utilization efficiency. the Wilsonville coal liquefaction facility first consisted of a single stage based on the SRC-II process. The reactor was a bubble column slurry reactor, which was modeled in the first year of this project. A second stage was later added at the Wilsonville liquefaction facility to improve three performance criteria, which affect the overall economics; process flexibility, product quality and hydrogen utilization efficiency. The second stage consisted of an ebullated bed catalytic reactor based on the H-Coal reactor concept. This process was then called the Integrated Two-Stage Liquefaction (ITSL) process. The objective of this project was to develop a model for the ebullated bed reactor so that models for both reactors in the ITSL process could be in place. The reactor model took into account the unexpected phenomenon of bed contraction in a three phase fluidized bed by utilizing the hydrodynamic model of Darton and Harrison (1975) which is based on the wake concept. The kinetic model used was developed for

the catalytic liquefaction of bituminous Elkhorn No. 3 coal. The plug flow model was used for both gas and slurry phases to describe their flow behavior. The program was written in FORTRAN in a modular form so that modifications can be easily made. 32 refs., 6 figs., 6 tabs.

36262 (DOE/PC/60054—T13, pp 44-102) **Coal liquefaction using transition metal carbonyl catalysts.** Feb 1987. NTIS, PC A11/MF A01. File Number DE87008403.

In Coal liquefaction: Investigation of reactor performances, role of catalysts and PCT properties: Final report.

Metal carbonyl complexes have been used as catalysts or catalyst precursors for the liquefaction of coal. There are two ways in which these complexes have been employed. As catalytic agents, transition metal carbonyl complexes are usually effective at temperatures below 250°C, depending on the CO pressure needed to prevent the complex from decomposing to yield the zerovalent metal. In some cases, temperatures above 250°C can be used but the CO pressure then must be very high to prevent decomposition of the complex. This is one method of using these catalysts in hydrogenation of coal constituents or coal-derived liquid products. It is important to note that organic covalent bonds are not split, to any extent, by metal carbonyl complexes at the low temperatures used. The second major method of using these transition metal complexes is as catalyst precursors. Here, the temperature is above 250°C, often reaching 450°C and the complex decomposes to finely divided, well-dispersed zerovalent metal which, in many cases, proves to be an effective catalyst for coal liquefaction. In this case, at the usual temperature of coal liquefaction, free radicals are formed by the splitting of various covalent bonds and the catalysts aid in the capping of these reactive species with hydrogen. It is important to be aware of these two very different modes of action of transition metal carbonyl compelxes in the catalytic liquefaction of coal. It is possible to employ both methods of using transition metal complexes, that is, hydrogenate susceptible bonds in coal at low temperatures using the transition metal complex and then use conventional coal liquid catalysts such as cobalt molybdate to complete the liquefaction of coal. In some cases, this works quite well. 36 refs., 4 figs., 21 tabs.

36263 (DOE/PC/60054—T13, pp 104-129) **Strong acids as catalysts for the direct liquefaction of coal.** Feb 1987. NTIS, PC A11/MF A01. File Number DE87008403.

In Coal liquefaction: Investigation of reactor performances, role of catalysts and PCT properties: Final report.

This review is concerned with the conversion of coal to liquids using very strong acids known as superacids. Superacids are acids with extraordinary protron strengths which are strong or stronger than 100% sulfuric acid. They can react with very weak bases, even with methane, to furnish a $CH_5^+$ carbocation which decomposes to $CH_3^+$ and hydrogen gas. The strongest superacids contain fluorine but the presence of this element is to be avoided because of difficulty of handling and tendency to be corrosive. Coal has been converted to liquids using fluorinated acids and the more stable, less corrosive solid superacids. The acidity of a number of solid oxides such as $Fe_2O_3$, $ZrO_2$ and $TiO_2$ is raised remarkably by addition of sulfate iron; thus $Fe_2O_3$-$SO_4^{2-}$ is thousands of times stronger as an acid than is $Fe_2O_3$. Strongly acidic catalysts were found to be active and selective for the liquefaction of a bituminous coal. Traditional hydrogenation catalysts appear more effective for lignite conversion to liquids. Evidently acidity properties of catalysts are important in carbon-carbon bond cleavage while hydrogenation ability of a catalyst is important for carbon-oxygen bond cleavage. The study of the direct liquefaction of coal with superacids is in its infancy and promises to yield new approaches to both coal conversion and to elucidation of the constitution of coal. 39 refs., 1 fig., 3 tabs.

36264 (DOE/PC/60054—T13, pp 130-155) **Coal liquefaction with liquid clathrates.** Feb 1987. NTIS, PC A11/MF A01. File Number DE87008403.

In Coal liquefaction: Investigation of reactor performances, role of catalysts and PCT properties: Final report.

This section provides a review of background information on the application of liquid clathrates for coal liquefaction. The advantages, limitations, and significance of coal liquefaction using liquid clathrates, in particular at low temperatures and pressures, is discussed. Coal liquefaction with liquid clathrates occurs at or near room temperature and requires neither application of heat nor consumption of hydrogen. The unique characteristics of coal dissolution with liquid clathrates lies in that the clathrate acts as a host and does not itself react with the coal. The loss of components used to produce the clathrate is small. However, the yields of coal liquefaction liquids with these clathrates are only about 25 to 40%. The future development of the liquid clathrate technique for coal liquefaction will depend largely on improving liquid yields and finding effective methods for clathrate recovery and regeneration. 13 refs., 1 fig., 4 tabs.

36265 (DOE/PC/70753—T11) **The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987.** Wilson, B.L. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1987. Contract FG22-84PC70753. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011047.

The main objectives of this project are the following: (1) Preparation and characterization of transition metal complexes with nitrogen, oxygen and sulfur donor ligands especially the poly(pyrazolyl)borate ligands. (2) Preparation of bimetallic complexes of molybdenum and other metals such as nickel, cobalt, and iron. (3) Determination of the ability of the above complexes to catalytically reduce polycyclic aromatic or heterocyclic compounds. (4) Evaluation of these complexes as coal liquefaction catalysts. (5) Evaluation of these complexes as desulfurization and denitrogenation catalysts. (6) Training of students in transition metal complex preparation and characterization and in the evaluation of metal complexes as process catalysts.

36266 (DOE/PC/70786—T9) **Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86.** Eisch, J.J. (State Univ. of New York, Binghamton (USA)). 1 Jan 1987. Contract FG22-84PC70786. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011268.

Basic to both the liquefaction of coal and the purification of coal liquids is the transfer of hydrogen from such sources as dihydrogen, metal hydrides or partially reduced aromatic hydrocarbons to the extensive aromatic rings in coal itself or to aromatic sulfides, amines and ethers. Accordingly, this study is exploring how such crucial hydrogen-transfer processes might be catalyzed by soluble, low-valent transition metal complexes under moderate conditions of temperature and pressure. By learning the mechanism whereby $H_2$, metal hydrides or partially hydrogenated aromatics do transfer hydrogen to model aromatic compounds, under homogeneous transition-metal catalysis, we hope to identify new methods for producing superior fuels from coal. During the ninth quarter of this three-year grant the following aspects of this study were pursued: (a) the homogeneous, nickel(0)-catalyzed disproportionative hydrogen shuttling of such dihydroaromatics as dihydrobenzenes, dihydronaphthalenes and dihydroanthracene was further investigated; (b) the intermolecular hydrogen-shuttling of dihydroaromatics and acceptor molecules, such as polycyclic aromatics, aryl-substituted ethylenes and acetylenes and azaaromatics, has been examined for the operation of nickel(0) catalysis; (c) complexes of nickel(0) bearing a variety of ligands have been tested as catalysts for the thermal cleavage of benzylic carbon-carbon bonds; (d) the possibility of a synergistic catalysis of nickel(0) complexes and Lewis acids on hydrogen-shuttling has begun to receive our earnest attention.

36267 (DOE/PC/70812—11) **Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987.** Haynes, H.W. Jr.; McCormick, R.L. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 26 Jun 1987. Contract FG22-84PC70812. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011263.

Two deactivation runs were completed during the last quarter. The performance of a commercial NiMo/alumina catalyst (AMOCAT 1C) was roughly equivalent to that of its CoMo/alumina analog (AMOCAT 1A). This suggests that high temperatures alone (825°F) cannot explain the relatively poor performance of NiMo as compared to CoMo that has been reported in previous

coal liquefaction studies. A CoMo/nitrided active carbon performed better than any of the carbon supported catalysts thus far studied, but performance fell short ofthe benchmark catalysts, AMOCAT 1A. The workup of a deactivation run with a CoMo/titania catalysts is now complete and results are reported. Two correlations of performance with catalyst properties are now beginning to emerge. A correlation of activity with micropore volume in the range 60 to 200 A pore diameter has been established. A similar correlation was reported earlier by Amoco researchers. We have also observed a negative correlation of carbon deposition with increase in acidity as determined by TPD of an organic base. This appears to contradict earlier findings in which a reduction of acidity by sodium impregnation resulted in less carbon on catalyst. 7 refs., 8 figs., 9 tabs.

36268 **(DOE/PC/80518—T7) Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987.** Sahin, T.; Ford, W.K. (Montana State Univ., Bozeman (USA)). 1987. Contract FG22-85PC80518. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010708.

Five samples were prepared and characterized by XPS in calcined, reduced and sulfided states. These catalysts will be used to study the adsorption characteristics of thiophene and cyclohexene in the SIMS/TPD chamber. We have done some preliminary TPD experiments to calibrate the instruments. At the moment the SIMS/TPD system is ready for TPD work. However, the SIMS work had to be deferred due to a defective VG ion gun power supply. In Ford's lab, the oxidation of the NiAl(110) surface has continued; we summarize some of the results here. Efforts to obtain reproducible Kelvin probe measurements of the work function upon oxygen exposure has continued. Future work includes continuation of (1) the adsorption studies and (2) oxidation characteristics of the (110)aluminum.

36269 **(DOE/PC/80525—T7) Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 7, March 1, 1987-May 31, 1987.** Hwang, C.C.; Chiu, C.L. (Pittsburgh Univ., PA (USA). School of Engineering). 30 Jun 1987. Contract FG22-85PC80525. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011084.

During the seventh report period, major tasks included: (1) simulation of three-dimensional flows in hydrocyclones under several sets of values of design and operational variables, (2) comparison of the simulated results with the measured to determine needs for adjustments of the mathematical modeling and computational techniques, and (3) laboratory measurements of the velocity profiles of the model cyclone A (vertex angle 30 degrees).

36270 **(DOE/PC/80908—4) Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987.** Cheng, J.C.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 16 Jul 1987. Contract FG22-85PC80908. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012091.

Ionic hydrogenation of organic compounds under acidic conditions involves a two stage reaction: (1) formation of a cation in the presence of acids either by protonation of an unsaturated functional group such as ketones, aldehydes, or by cleavage of a carbon-heteroatom linkage such as ethers, alcohols, or phenols; (2) reduction of the so formed cation by a hydride donor, which can be an organic reagent, such as triethyl-silane, isopropylalcohol, or hydrogen gas in the presence of a proper catalyst. The only published applications of ionic hydrogenation to coals with very strong acids and hydrogen gas are nonselective and are therefore useless for our purpose. In this work: (1) ionic hydrogenation of low rank coals will be studied using $H_2O$:$BF_3$ as the acid and hydrogen gas as the hydride donor in the presence of catalytic quantities of transition metal complexes used to activate hydrogen; (2) optimum reaction conditions will be developed. Reactions with model compounds will be studied to explore and characterize the ionic hydrogenation chemistry. The reaction products will be characterized using standard, appropriate techniques such as NMR, gas chromatography, and mass spectrometry. Interesting new ionic hydrogenation systems will be applied to coals in an attempt to develop efficient room temperature coal conversion chemistry. The degree of hydrogenation, depolymerization, and other chemical changes occurring during coal conversion will be evaluated by applying standard analytical techniques to the pyridine and toluene extracts of the reacted coals as well as to the solid products.

36271 **(DOE/PC/90529—2) Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 December 1986-15 March 1987.** Calo, J.M.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1987. Contract FG22-86PC90529. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011683.

In this second quarterly technical progress report, we present some additional developments concerning the analysis of the effect of activated micropore diffusion on gasification reactivity, and report on progress with the experimental apparatus: (1) The Autoclave Engineers 3" Berty catalytic reactor has been reassembled and tested, and has been found to function satisfactorily. However, the mass spectrometer malfunctioned and had to be repaired. (2) The effect of sorbate partial pressure on micropore diffusion and gasification reactivity have been examined. It was found that: pressure can have a significant effect on micropore diffusivities; increasing pressure generally increases the microparticle effectiveness factor for pressures far from saturation (while the opposite is true at near-saturation conditions); and the effect of sorbate partial pressure should be considered in conducting and interpreting measurements regarding micropore diffusion. 6 refs., 1 fig., 1 tab.

36272 **(DOE/PC/90909—T3) Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987.** Miller, R.L.; Baldwin, R.M. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). Jun 1987. Contract FG22-86PC90909. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010752.

During the third quarter of this project, efforts were directed towards evaluating the extent of model nitrogen compound adduction during low severity bituminous coal liquefaction. Results suggested that dipropylamine and 1,2,3,4-tetrahydroquinoline did not adduct to any observable extent, while approximately 14 wt % 4-piperidinopyridine was found to adduct primarily into the THF insoluble residual product fraction. Coal conversion data from low severity bituminous coal experiments using seven model nitrogen compounds was correlated as a function of nitrogen compound pK/sub b/ value. Additional experimental work designed to evaluate the effects of coal rank and feed gas composition has been completed. Results from this work is presently being analyzed and will be presented in future reports. 4 refs., 4 figs., 4 tabs.

36273 **(EPRI-AP—5221) Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report.** (Southern Co. Services, Inc., Birmingham, AL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. Contract AC22-82PC50041. 409p. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87011616.

This report presents the operating results for Runs 246 and 249 at the Advanced Coal Liquefaction R & D Facility in Wilsonville, Alabama. These runs operated in a Two-Stage Liquefaction (TSL) mode using Wyodak (upper seam) subbituminous coal from the Clovis Point mine. The primary objective of Run 246 was to obtain performance data for the TSL system and the individual process units. Secondary objectives were to demonstrate operability for the system and the respective process units, and to maintain an "all-distillate" (minimum resid yield, <5% MAF coal) product slate. The initial run configuration utilized a Double Integrated mode with two recycle streams to the thermal unit. An Integrated mode with a single recycle stream to the thermal unit was used from 13 June onward. The stated objectives were attained in both operating modes. Operating conditions were adjusted to obtain high coal conversions, acceptable deashing performance, and an "all-distillate" product slate. The primary objective of Run 249 was dem-

onstration of unit and system operability for subbituminous coal in the Reconfigured Integrated Two-State Liquefaction (RITSL) mode of operation with a forced backmixed dissolver in the thermal liquefaction unit. In RITSL the products from the thermal (first stage) unit are sent to the hydrotreater (second stage) unit without prior deashing. The hydrotreated resid and ash are sent to the Critical Solvent Deashing unit, and the deashed resid is then recycled to the thermal unit. Operating conditions were adjusted to obtain high coal conversion, acceptable deashing performance, and an "all-distillate" product slate. Included in Run 249 were evaluations of the effects of iron oxide, dimethyl disulfide, and water as reaction additives on coal conversion, product quality, gas make, catalyst activity, and energy rejection. A test of ash recycle was also included in the run. 34 refs., 82 figs., 53 tabs.

**36274 (NP—7770115) Modelling of chamber coking as a reaction determined by heat transport.** Vervuert, M. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Verfahrenstechnik). 11 Feb 1985. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770115.

A heat transport model is submitted, which makes it possible to calculate the two-dimensional temperature field over the width of the oven and at each height level of the lining and the rotor of technical and of experimental coke ovens. The heating of the damp lining to the boiling point of water, the loss of mass of the lining by pyrolysis and the inflow and outflow of heat at the bottom and in the gas collection chamber are included. The description of the pyrolysis of the coal used is done for a summed component 'primary volatile components' by an equation of the 1st order from the literature for the speed of reaction with a distribution of the activation energy into 5 discrete areas, and by product equations of reactions of the 1st order and the ELOVICH equation for splitting off individual components. The solution of the coupled system of equations obtained from the model equations and the basic balance equation is done with a numerical implicit differential process, where specific boundary cases are compared with an analytic solution previously worked out. (orig./MOS).

**36275 (PB—87-183588/XAB) Control-technology assessment for coal gasification and liquefaction processes.** Telesca, D.R. (Dynamac Corp., Rockville, MD (USA). Enviro Control Div.). Apr 1982. 14p. NTIS, PC A02/MF A01.

The control technology available to prevent exposure to harmful substances during coal-conversion operations is evaluated for the TOSCOAL Coal Pyrolysis Process which is being developed at the Tosco Rocky Flats Research Center, located in Golden, Colorado. In this process, crushed dry coal is preheated in lift pipes. Hot flue gas from the ball heater supplies the heat. Preheated or partially deagglomerated coal is fed to a rotating pyrolysis drum, where it is contacted with hot ceramic balls and heated in a ball heater fired by clean process-drived fuel gas or fuel oil. Potential hazards exist through possible exposure to noise, heat stress, high temperatures, flammable or explosive materials, respirable coal and char dust, coal tar pitch volatiles, and toxic gases such as carbon monoxide and hydrogen sulfide. The major way to eliminate, or at least minimize, possible exposure to these hazards is through the use of a closed-system operation. The potential hazards associated with coal pulverizing, slurry preparation, hydrogenation, and solid-from-liquid separation do not apply as they are not used in the TOSCOAL process.

**36276 (PB—87-185559/XAB) Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report.** Chiche, P.; Gaget, J.; Giuliani, P.; Jacquin, Y. (Commission of the European Communities, Luxembourg). 1984. 45p. (In French). (EUR—9080-FR). NTIS, PC PC E04/MF E04.

Customers in the European community countries should apply to the Office for Official Publications of the European Communities, B.P. 2985, Luxembourg.

The research set out to use the CERCHAR plant for the hydroliquefaction of coal to study the potential of processing asphalts by hydrogenation to produce lighter or less-viscous products and so contribute to the petroleum industry's increasing need for medium and light distillates. Preliminary work including adapting the plant to handle loads more viscous and richer in sulfur than normal, lowering the viscosity level of the charge and choosing appropriate catalysis at the laboratory level to encourage desulfurization, demetallization, and conversion into light fractions. Four hydrogenation tests were then carried out at variable temperature above 400°C and under a pressure of 150-200 bars with highly divided catalyst in suspension demonstrated an intense demetallization as well as high conversion rate with lower coke formation.

**36277 (STEV-BF—86-10) Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30.** Sjoestroem, K. (Statens Energiverk, Stockholm (Sweden); Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology). 29 Oct 1986. 231p. (In Swedish). (KTH-KTR—86-57). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752396.

The task of the project is to develop LDU Laboratory development unit and LRU Laboratory research unit reactors including the pressurized flash pyrolysis plant. Gasification of wood has been performed in the LDU-reactor at 3-10 bar pressure. The fluidizing behaviour of char has been studied and flash pyrolysis of peat has been made under pressure. Decomposition of tar by means of dolomite has been studied and the products have been analysed. Sulfur poisoning of a Ni catalyst when reforming methane at increased pressure has been investigated. Modelling of the gasification stage is in progress.

**36278 (VTT-TUTK—455) Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application.** Arpiainen, V.; Kylloenen, H.; Nissilae, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Nov 1986. 172p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752481.

Flash pyrolysis is the rapid thermal decomposition of an organic raw material in an oxygen-free atmosphere. Research on the flash pyrolysis of biomass is a rather new field, whilst pyrolysis research based on slow heating rates has long traditions. A gaseous fraction and a liquid fraction and a solid residue are obtained as products. The yields of these fractions are determined by the chemical structure and properties of the raw material, and by the pyrolysis conditions. Effects of feedstock characteristics and pyrolysis conditions on the thermal decomposition of wood, peat, bark, and lignin are discussed. Basic and applied research programmes being carried out at different research institutes and the corresponding test equipment are presented. Results obtained in the various research programmes are compared and evaluated. Various possibilities of applying flash pyrolysis industrially in Finland are considered: substitution of heavy fuel oil by pyrolysis oil, production of chemicals from liquid pyrolysis products, and production of gases, primarily olefins, for further conversion. The most promising short-term industrial applications are processes producing tar for use as fuel oil or for further processing. At this time, it is difficult to evaluate the tar conversion processes, as tar from flash pyrolysis is not yet properly characterized and several aspects of tar recovery are uncertain. For the long term, the capability of producing olefins economically from biomass is also worth considering. An experimental program has recently been initiated. The main aims is to study the chemistry of tar formation and decomposition over a wide range of temperature.

**36279 Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts.** Tischer, R.E.; Narain, N.K.; Stiegel, G.J.; Cillo, D.L. (Engineering Research Div., Pittsburgh Energy Technology Center, US Dept. of Energy, Pittsburgh, PA). *Industrial and Engineering Chemistry Research;* **26**: No. 3, 422-426(Mar 1987).

The catalysts contained 3 wt % NiO and 19.8 wt % MoO/ sub 3/. They were tested in a 50/50 mixture of coal-liquid residuum and process-derived solvent at 390°C and 2000 psig in a batch autoclave test. The addition of phosphorus has a significant effect on the ability of the catalyst to convert heavy coal liquids into products soluble in cyclohexane. The initial addition of phosphorus pentoxide causes an increase in this conversion, while addition of amounts in excess of 8 wt % reverses the trend and causes the ac-

tivity to decline to values less than the activity of the phosphorus-free catalyst.

**36280 Hydrodynamics of four-phase fluidization: Comparison of cold-flow and operating reactor data for a gas/liquid/coal slurry fluidized bed.** Rundell, D.N.; Schaefer, R.J.; Shou, J.K. *Industrial and Engineering Chemistry Research;* **26**: No. 3, 613-617(Mar 1987).

The fluid dynamics occurring in Hydrocarbon Research Inc.'s (HRI's) H-Coal process development unit (PDU) coal liquefaction reactor during run PDU-10 were measured and compared with fluidization data obtained in a dimensionally similar cold-flow glass pilot plant. It was found that catalyst bed expansions and gas holdups were higher in the operating reactor than those observed in cold-flow tests with kerosene/coal char slurries having the same nominal density and viscosity as the coal/oil slurries of the PDU experiments.

**36281 Catalytic coprocessing: Effect of catalyst type and sequencing.** Curtis, C.W.; Tsai, K.J.; Guin, J.A. (Chemical Engineering Dept., Auburn Univ., Auburn, AL 36849). *Industrial and Engineering Chemistry Research;* **26**: No. 1, 12-17(Jan 1987).

The importance of catalyst accessibility, loading, and type in coprocessing coal with heavy residua was evaluated by examining the changes in the product slate and the production of upgraded products. A commercial hydrotreating catalyst (NiMo/Al/sub 2/O/sub 3/), bulk metal sulfides (FeS/sub 2/ and MoS/sub 2/), a homogeneous catalyst (H/sub 2/S), and four oil-soluble metal salts or organic acids were used. The more accessible NiMo/Al/sub 2/O/sub 3/ powder promoted higher conversion and more upgrading than did the less accessible extrudates. The oil-soluble catalyst precursors showed higher levels of activity for coal conversion and oil production in the coprocessing reaction than did either NiMo/Sl/sub 2/O/sub 3/ or pyrite at equivalent loading. The product slates from catalyst sequencing in two-stage coprocessing were examined and compared to the results obtained from single-stage processing at comparable conditions.

**36282 Disposable catalysts in coal liquefaction.** Narain, N.K.; Cillo, D.L.; Stiegel, G.J.; Tischer, R.E. (Pittsburgh Energy Technology Center, PA). pp 111-149 of Coal science and chemistry. Volborth, A. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers (1987).

The efficient utilization of hydrogen is believed to be one of the more critical aspects of direct liquefaction, not only from the standpoint of reaction mechanism and reaction chemistry but also from economic considerations. It is apparent that maximizing liquid hydrocarbon yield while minimizing hydrogen consumption could be most important economic consideration in coal liquefaction. This is where the role of a catalyst as a method of hydrogen transfer becomes vital. This paper discusses slurry phase (disposable) catalysis in direct coal liquefaction and in particular, to the iron sulfide/$H_2S$ system. 118 references.

**36283 High-temperature control of contaminants in coal-derived gases.** Cicero, D.C.; Jain, S.C.; Halow, J.S. (Morgantown Energy Technology Center, WV). pp 175-198 of Chemical separations. Volume II. Applications. King, J.C.; Navratil, J.D. (eds.). Arvada, CO; Litarvan Literature (1986). (CONF-860411—).

From 1. international conference on separations science and technology; New York, NY, USA (15 Apr 1986).

The US Department of Energy is currently sponsoring various projects aimed at identification and control of contaminants in hot gas streams produced by both coal gasification or combustion. Contaminants in these streams and the costs associated with controlling them by conventional methods are the main limitations on the commercialization of many advanced coal technologies for power generation. The advanced power generation systems of interest to the Department include integrated gasification combined cycles using gas turbines, direct coal-fired turbines, coal gasification systems using fuel cells, and pressurized fluidized-bed combustion systems. Contaminants which affect these systems or which may result in adverse environmental emissions include sulfur, alkali metals, particulates, chlorides, nitrogen, and various trace metals. This paper describes the effects of coal contaminants on these power generating systems and recent advances made in methods of controlling them. 16 references.

**36284 Effect of pore-distributed coke on catalyst regeneration kinetics.** Chang, Y.; Perlmutter, D.D. New York, NY; American Institute of Chemical Engineers (1986). 50p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Prior experimental study demonstrated that catalyst regeneration rates vary with conversion, showing a slight shallow maximum in rate at an intermediate conversion level. This peculiar reaction behavior calls for explanation in terms of pore structural changes. In this work, a mathematical model is developed based on the interaction between catalyst pore structure and coke distribution in the pores. The model is able to associate overall regeneration kinetics with alternative pore-distributed coke deposition patterns. Results exhibit a shallow rate maximum, in agreement with the prior experimental report. The model makes coke distribution in the pores accessible to experimental determination. The numerical results indicate that among pore structures with the same mean and overall pore volume, a larger variance offers a higher threshold for coke loading; for a given degree of dispersion, a smaller mean allows a higher coke loading.

**36285 SNG from coal is a viable and required future energy supply option.** Miller, C.L. (Office of Fossil Energy, U.S. Dept. of Energy, Washington, DC 20545). pp 81-92 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

The development of the technology for the economic production of substitute natural gas (SNG) from coal certainly can be considered as the most recent and definitive example of this cyclic phenomena in the interest and support of coal gasification technology development. Since the energy use patterns have changed and as other energy supply options have evolved, the relative emphasis on coal gasification as a means of providing a substitute natural gas continues to be a comparatively low priority R and D effort. The timeframe for both the validation and commercialization of the technology is significantly different than what was envisioned in the 1970's. Another cycle of interest in this energy supply option (i.e., gasification processes to convert coal into SNG) has been completed. If the past is prologue to the future, it's time now to plan for and anticipate the next cycle. These factors leading to the conclusion that this next cycle has begun also support the growing realization that SNG is a viable and required future energy supply option.

**36286 TRW Gravimelt Process for desulfurization and demineralization of coal.** Meyers, R.A.; Mc Clanathan, L.C.; Hart, W.D. New York, NY; American Institute of Chemical Engineers (1985). 6p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

The TRW Gravimelt Process is a Department of Energy supported chemical coal-cleaning process that removes virtually all of the sulfur and ash from coal. Coal cleaned by the process meets EPA New Source Performance Standards (NSPS Standards) for sulfur oxide emissions and is as low in ash and sulfur as fuel oil. The TRW Gravimelt Process involves treatment of coal with molten sodium and potassium hydroxides at temperatures of 325°-390°C to chemically extract organic and pytritic sulfur and the coal mineral matter into the molten alkali. A series of conceptual designs and cost estimates for 9080 metric tonne (10,000 tons) per day TRW Gravimelt Process commercial plants have been prepared with variations in reactor type, of ratio of caustic to coal, washing system and regeneration options.

**36287 Effect of pore structure on the char-steam reaction.** Chi, W.K.; Perlmutter, D.D. New York, NY; American Institute of Chemical Engineers (1985). 29p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Chars exhibiting different pore structures were generated from a high volatile bituminous coal and used to study gasification with steam. The reactions were in the regime of chemical kinetic control over the temperature range between 1123 and 1273 K. The reaction rate data were interpreted using the random pore model developed by others. The reaction rate was found to be highly correlated with the surface area development at various conversions of chars, independent of the temperature.

**36288 Characterization of pore structure changes during gasification.** Foster, M.; Jensen, K.F. New York, NY; American Institute of Chemical Engineers (1985). 21p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Small angle x-ray scattering (SAXS) has been used to monitor changes in the internal structure of carbonaceous material during gasification. The technique has the advantage of being nonintrusive and offering the potential for measurements at gasification conditions. The interpretation of SAXS data and associated evolution of surface areas and pore size distribution is discussed in terms of different modeling options.

**36289 Vacuum still bottoms viscometer.** Dinsmore, T.V.; Wilson, J.H. New York, NY; American Institute of Chemical Engineers (1985). 30p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC05-84OR21400.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

97A.

A viscometer system that is capable of measuring VSB viscosity on-line has been designed, constructed, and tested. The viscometer will not only provide continuous on-line measurements for process control purposes, but will also determine viscosity as functions of temperature and shear rate. The latter results may be used to verify design-base information for direct coal liquefaction demonstration plants. The viscosities of Wilsonville samples of VSB and LSRC were determined as functions of shear rate and, in the case of LSRC, temperature. The VSB viscosity was found to be shear-rate sensitive, while the LSRC viscosity was temperature sensitive.

**36290 A two-stage bench scale catalytic reactor system.** Pacheco, M.A.; Schwartz, M.M.; Tait, A.M.; Mahoney, J.A. New York, NY; American Institute of Chemical Engineers (1985). 19p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

79C.

The continuous aging unit has proven to be an extremely useful tool for catalyst development. With appropriate experimental design and data analysis, it is proving to be as an inexpensive tool for screening advanced processing schemes. It fits in with, and in some cases, overlaps out other two tools (microautoclave and batch screening unit) to provide a very cost effective network of experiment facilities for developing multi-stage catalytic processes for the hydroliquefaction of coal.

## 0105 By-products

**36291 (PB—87-188538/XAB) Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio.** O'Malley, M.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 12p. (HETA—85-441-1765). NTIS, PC A02/MF A01.

In response to a request from the Industrial Commission of Ohio, worker complaints of skin disease at the New Boston Coke Corporation, New Boston, Ohio were investigated. The request was based on seven reports of dermatitis thought to be associated with steam exposure during coke quenching. Quench water had a pH of 8.85 and contained phenol, ammonia, calcium-oxide, and suspended particulates (82% organic compounds); no irritant threshold levels were found for these compounds. Skin tests in rabbits showed a minimal irritant capacity for quench water. Medical records did not reveal the origin of dermatitis. Active skin lesions were characterized as nummular eczema or atopic dermatitis, which were not thought to be of occupational origin. The author concludes that coke-quenching steam does not pose a skin hazard, but certain work activities may aggravate existing skin conditions. Recommendations include elimination of abrasive cleansing agents, use of skin moisturizers after washing, and prompt medical evaluation of skin complaints.

## 0106 Properties

*REFER ALSO TO CITATION(S) 36270, 36288, 36355, 36474, 37849*

**36292 (CONF-861131—3) An experimental study of heat of immersion of coal.** Melkus, T.G.; Chiang, S.H.; Wen, W.W. (Pittsburgh Univ., PA (USA); USDOE Pittsburgh Energy Technology Center, PA). 1986. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011819.

From 6. intersociety cryogenics symposium; Miami Beach, FL, USA (2 Nov 1986).

The heats of immersion of six coals were measured at 303K in water with a Setaram C-80 microcalorimeter. The effects of coal rank, surface oxidation state, moisture content, petrographic constituents, and particle size on the wetting characteristics and surface properties were investigated. The six coals and four other solids (pyrite, kaolin, slate, and graphite) were characterized in terms of relative hydrophobicity or hydrophilicity via the comparison of heat of immersion measurements in water and in an organic liquid. Heat of immersion measurements were also made of coal in surfactant solutions (Aerosol OT, Triton X-114, and dodecyl pyridinium chloride) of varying concentrations. The results of the various experiments were found to correlate well with independent flotation and vacuum filtration tests. 12 refs., 7 figs., 4 tabs.

**36293 (CONF-870212—3) Immersion calorimetry of fine coal particles and its relation to flotation.** Melkus, T.G.; Chiang, S.H.; Wen, W.W. (USDOE Pittsburgh Energy Technology Center, PA; Pittsburgh Univ., PA (USA)). 1987. 12p. NTIS, PC A02. File Number DE87011817.

From Annual meeting and exhibition of the Society of Mining Engineers; Denver, CO, USA (24 Feb 1987).

A Setaram C-80 heat flux microcalorimeter was used to study the surface and interfacial properties of fine coal particles in water containing flotation agents via heat of immersion measurements. Heat of immersion (ΔH/sub imm/) is usually a small exothermic quantity and can be used to characterize a solid in terms of its relative hydrophobicity or hydrophilicity. The effects of coal type, surface oxidation, mineral matter content, kerosene concentration, and pH on the wetting characteristics were investigated. Although coal is a heterogeneous mixture of organic and inorganic materials, immersional calorimetry has proven to be quite helpful in measuring surface properties of coal, and the following conclusions can be drawn: The heat of immersion decreased with increasing kerosene concentration, which corresponds to the coal particles increasing hydrophobicity; in varying the pH, the ΔH/sub imm/ went through a minimum at a pH value of 6.5 to 7.0, which coincides with the reported optimum pH range for flotation; both oxidation and clay slime coating (addition of kaolin), which are known to make the coal less hydrophobic, increased the ΔH/sub imm/; and the trends that were shown to exist in the heat of immersion measurements (for varying kerosene concentration, pH oxidation, and clay slime coating) correlated well with independent flotation experiments. 16 refs., 6 figs., 2 tabs.

36294 **(CONF-870410—31) Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin.** Hayatsu, R.; Botto, R.E.; McBeth, R.L.; Scott, R.G.; Winans, R.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011527.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The maceral sporinite is thought to be derived from spores and pollen. Both sporinite and sporopollenin, the insoluble cell wall residue after chemical treatment, are considered to have a highly polymerized, cross-linked aliphatic structure with some aromatics. Many investigators have endeavored to characterize the physical and chemical nature of sporinites and sporopollenin; however, their chemical structures have not been well defined. Furthermore, little is known about how sporopollenin transforms to sporinites during the early stage of coalification. Aim of the present study is to compare chemical structures of an immature sporinite and its precursor, sporopollenin. In a parallel experiment, the transformation of sporopollenin into a synthetic sporinite has been carried out in the laboratory using thermal catalytic reactions under conditions of simulated catagenetic maturation.

36295 **(CONF-870764—1) The solubilization of low-ranked coals by microorganisms.** Strandberg, G.W. (Oak Ridge National Lab., TN (USA)). 09 Jul 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011114.

From Seminar on microbial processing of coal in studiengesellschaft Kohlegewinnung Zweite generation; Essen, F.R. Germany (9 Jul 1987).

Late in 1984, our Laboratory was funded by the Pittsburgh Energy Technology Center, US Department of Energy, to investigate the potential utility of microorganisms for the solubilization of low-ranked coals. Our approach has been multifacited, including studies of the types of microorganisms involved, appropriate conditions for their growth and coal-solubilization, the suceptibility of different coals to microbial action, the chemical and physical nature of the product, and potential bioprocess designs. A substantial number of fungal species have been shown to be able to solubilize coal. Cohen and Gabrielle reported that two lignin-degrading fungi, Polyporous (Trametes) versicolor and Poria monticola could solubilize lignite. Ward has isolated several diverse fungi from nature which are capable of degrading different lignites, and our Laboratory has isolated three coal-solubilizing fungi which were found growing on a sample of Texas lignite. The organisms we studied are shown in Table 1. The perceived significance of lignin degradation led us to examine two lignin-degrading strains of the genus Streptomyces. As discussed later, these bacteria were capable of solubilizing coal; but, in the case of at least one, the mechanism was non-enzymatic. The coal-solubilizing ability of other strains of Streptomyces was recently reported. Fakoussa and Trueper found evidence that a strain of Pseudomonas was capble of solubizing coal. It would thus appear that a diverse array of microorganisms possess the ability to solubilize coal. 16 refs.

36296 **(CONF-870802—5) Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms.** Buchanan, A.C. III; Biggs, C.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008805.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Attempts to understand the thermal chemistry of coal at the molecular level are severely complicated by its inherent properties: a diverse array of structural units (e.g., aromatic, hydroaromatic, and heterocyclic aromatic clusters connected by short aliphatic and ether links) and functional groups (e.g., phenolic hydroxyls, carboxyls, and basic nitrogens) in a cross-linked macromolecular framework with no repeating units. One simplifying experimental approach has been the study of individual model compounds that highlight structural features in coal. A complicating feature in the interpretive extrapolation of model compound behavior to coal is the possible modifications in free-radical reactivity patterns resulting from restricted translational mobility in the coal where breaking one bond in the macromolecular structure will result in radical centers that are still attached to the residual framework. We are modeling this phenomenon by studying the thermolysis of model compounds that are immobilized by covalent attachment to an inert surface. Previous studies of surface-immobilized bibenzyl (1,2-diphenylethane) showed that immobilization can profoundly alter free-radical reaction pathways compared with the corresponding fluid phase behavior. In particular, free-radical chain pathways became dominant decay routes leading to rearrangement, cyclization, and hydrogenolysis of the bibenzyl groups. In this paper we describe preliminary results on the effects of surface immobilization on the thermolysis of 1,3-diphenylpropane, whose fluid phase behavior has been extensively investigated. 9 refs., 1 fig.

36297 **(CONF-870802—9) Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample.** Chambers, R.R. Jr.; Hagaman, E.W.; Woody, M.C. (Oak Ridge National Lab., TN (USA)). 30 Aug 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011667.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

It has been demonstrated that important coal structural information can be established by the application of selective chemical modification reactions to derivatize independently the acidic O-H and C-H sites in coal. For example, it is possible to 0-alkylate the phenols and carboxylic acids in bituminous and subbituminous coals by reaction with hydroxide and methyl iodide or methyl tosylate. We have found that is is possible to 'fine tune' this 0-methylation reaction in favor of carboxyl vs phenolic 0-methylation by limiting the amount of hydroxide base and replacing the methyl iodide or methyl tosylate with dimethyl sulfate. Specifically, the coal is treated with an excess of TBAH. After a specified time period (16 h), the excess base is neutralized with HCl. This 'back titration' with acid is monitored, a glass electrode being used to evaluate the pH of the solution. After equilibration, the resulting coal anions are quenched with C-13, C-14 double labelled dimethyl sulfate. The pH dependency of the reaction is evaluated by measuring the total number of introduced methyl groups using C-14 combustion analysis. The number of methyl esters in the alkylated coals is defined as the number of hydroxide labile methyl groups measured by hydrolysis. The reaction selectivity can be optimized by careful control of the reaction pH. The 'site specificity' of the reaction can be evaluated quantitatively by measuring the ratio: base labile methyls to total methyls. An important step in the selective methylation of the acidic C-H sites in coal is the conversion of the phenols and carboxylic acids to their methyl ether and methyl ester derivatives. This is accomplished by the preparation of a pH 12 0-methyl coal using natural abundance dimethyl sulfate as the methylating agent.

36298 **(CONF-8609178—1) An automated microscopic method for the determination of pyrite size distributions in crushed coal.** Irdi, G.A.; Rohar, P.C. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011812.

From Society of Mining Engineering of AIME fall meeting; St. Louis, MO, USA (7 Sep 1986).

An automated method of microscopy for determining the pyrite size distribution on two base coals that were crushed to 28 mesh x 0 has been developed. Polished epoxy-bound coal pellets were prepared and examined by a Zeiss IBAS image analyzer utilizing a program developed from provided software. Pyrite size disribution determination is considered a necessary first step in pyrite characterization that could lead to successful predictions, by microscopy, of a coal's theoretical pyritic sulfur removal. Our research efforts to date have indicated that the IBAS can be a reliable instrument for determining pyrite size distribution in crushed coal. A program was also developed to convert pyrite size data to a weight basis for comparisons to the results from chemical analyses. The problems encountered in our research and their solutions will be presented in the discussion. 5 refs., 8 figs., 6 tabs.

36299 **(DOE/MC/19210—2357) X-ray Computed Tomography of coal: Final report.** Maylotte, D.H.; Spiro, C.L.; Kosky, P.G.; Lamby, E.J. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Dec 1986. Contract AC21-82MC19210. 278p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87010863.

X-ray Computed Tomography (CT) is a method of mapping with x-rays the internal structures of coal. The technique normally produces 2-D images of the internal structures of an object. These images can be recast to create pseudo 3-D representations. CT of coal has been explored for a variety of different applications to coal and coal processing technology. In a comparison of CT data with conventional coal analyses and petrography, CT was found to offer a good indication of the total ash content of the coal. The spatial distribution of the coal mineral matter as seen with CT has been suggested as an indicator of coal washability. Studies of gas flow through coal using xenon gas as a tracer have shown the extremely complicated nature of the modes of penetration of gas through coal, with significant differences in the rates at which the gas can pass along and across the bedding planes of coal. In a special furnace designed to allow CT images to be taken while the coal was being heated, the pyrolysis and gasification of coal have been studied. Gasification rates with steam and $CO_2$ for a range of coal ranks have been obtained, and the location of the gasification reactions within the piece of coal can be seen. Coal drying and the progress of the pyrolysis wave into coal have been examined when the coal was subjected to the kind of sudden temperature jump that it might experience in fixed bed gasifier applications. CT has also been used to examine stable flow structures within model fluidized beds and the accessibility of lump coal to microbial desulfurization. 53 refs., 242 figs., 26 tabs.

36300 (DOE/METC—86/6069, pp 13-23) **Development of inductively coupled plasma spectroscopy for on-line analysis.** McCarty, D.L.; Romanosky, R.R.; Chisholm, W.P. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Instrumentation is not currently available that will provide a simultaneous, multi-element, on-line, real-time, total quantitation of trace metals in gas streams, such as combustor and gasification streams. Information on the identification and quantification of trace elements is important due to environmental concerns (i.e., arsenic, selenium, cadmium, and chromium); corrosion potential (i.e., sodium and potassium); and as indicators of process performance/stability (i.e., zinc and iron in hot gas zinc ferrite-based sulfur removal processes). Vapor-phase or particulate-bound trace metals in hot process streams are normally collected in cooled impinger trains for off-line analysis by atomic absorption or other techniques. Using conventional instrumentation and methods, there is a lag time before extractive solid samples derived from a gas stream are analyzed in the laboratory for trace metal content. An inductively coupled plasma- (ICP) based atomic emission spectrometer is being developed at METC specifically for the purpose of providing on-line, real-time, multi-element analysis data for a process slipstream which could be used to immediately determine how changes in process parameters affect process output. The ICP is being investigated due to its ability to provide a very hot (>6000 K), stable, emission source capable of analyzing over 70 elements with the majority at the parts per billion level and having a dynamic range extending into the high parts per million. The instrument and progress to date are described.

36301 (DOE/METC—86/6069, pp 24-33) **Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high molecular weight coal components.** Smith, R.D.; Chess, E.K. (Pacific Northwest Lab., Richland, WA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC06-76RL01830.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

This program is aimed at the development of new analytical technologies for the characterization of previously intractable complex mixtures. The specific goals of this program are twofold: 1) to develop and evaluate combined high-resolution capillary column supercritical fluid chromatograph/high-performance mass spectrometer (SFC/MS) that is capable of analyzing high-molecular-weight materials, such as polar and heavy-end components found in coal conversion processes; and 2) to use this system to develop and evaluate analytical technology applicable to coal process development technology. Polar fluid systems most appropriate for polar and heavy-end materials will also be developed and evaluated. This program is expected to provide a greatly improved characterization of complex high-molecular-weight and polar materials, and to determine the feasibility of using SFC/MS methods for on-line characterization of coal conversion processes. The effort includes evaluation of quantitative instrumental approaches, of various ionization modes, and of MS/MS techniques for analyzing individual components in complex mixtures, and will serve to define the range of applicability and utility of high-performance SFC/MS methods. Progress to date is described. 8 references.

36302 (DOE/METC—86/6069, pp 34-43) **Optical detection of alkali compounds.** Oldenborg, R.C.; Baughcum, S.L. (Los Alamos National Lab., NM). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

An attractive option for the future generation of electrical power is to drive gas turbines with fuels derived from the economically priced and domestically prevalent resource coal. However, turbine components are susceptible to corrosion and deposition from even trace amounts of certain inorganic contaminants, particularly the alkali metals and their compounds. Alkali compounds can be destructive at even ppb levels, depending on their composition (halides, hydroxides, sulfates, or oxides) and form (molecular or particulate). The objective of this program is to develop a laser-based diagnostic technique, which should be applicable to the direct monitoring of trace levels of gas-phase alkali compounds within the post-combustion coal gas stream. The technique currently under investigation is based on the observation that emission is detected from alkali atoms upon ultraviolet photodissociation of alkali-containing compounds. Results are discussed. 6 references, 4 figures.

36303 (DOE/METC—86/6069, pp 44-53) **Laser-based infrared spectroscopy for trace analysis of process streams.** Draeger, J.A. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Laser-based infrared spectroscopy is being investigated for its applicability to perform on-line and in situ real-time trace gas analysis. Initial emphasis will focus on detection of trace concentrations of gaseous ammonia, hydrogen sulfide, and hydrogen cyanide. Preliminary laboratory results include the absorption of infrared radiation by a sample of ammonia via transmission spectroscopy using a tunable $CO^2$ laser as an infrared source. There exist many coincidences of the ammonia inversion modes and the $CO_2$ laser emissions between 9.1-11.1 microns. One approach is to utilize photoacoustic spectroscopy, since it offers a very sensitive method of detection for trace gas species. Detection limits of trace gases such as ammonia, hydrogen sulfide, and hydrogen cyanide will be determined and correlated with temperature, pressure, and interfering species effects. An on-line photoacoustic samples chamber has been designed and fabricated, and a prototype photoacoustic spectrometer is currently being assembled. The excitation sources will include an F-color center laser with a wavelength range of 1.5-3.5 microns, a carbon monoxide laser (5.0-6.5 microns), and a carbon dioxide laser (9.1-11.1 microns). Work in progress includes: compilation of a photoacoustic spectral library of undesirable gas species; interfacing an F-color center laser to the photoacoustic spectrometer for detection of hydrogen sulfide and hydrogen sulfide and hydrogen cyanide; procurement of a high-temperature, high-pressure infrared gas cell; extending spectral library to process stream condition ranges; and investigation of depth profiling of particulate matter by photoacoustic spectroscopy. The production, conduction, and detection of photoacoustic signals are discussed in this presentation. 4 references, 8 figures, 1 table.

36304 (DOE/METC—86/6069, pp 54-63) **Advanced coherent Raman diagnostics for coal gasification streams.** Taylor, D.J. (Los Alamos National Lab., NM). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Previous work on Coherent Anti-Stokes Raman spectroscopy (CARS) resulted in the successful detection of majority and certain minority species for nonintrusive, on-line, real-time analysis in gasifier streams. The detection of minority species by CARS, however, is limited to >100 ppm because of fluctuations in the nonresonant contribution and hence improve the detection sensitivity. This program will evaluate the usefulness of these advanced coherent Raman techniques have been developed that eliminate this nonresonant contribution and hence improve the detection sensitivity. This program will evaluate the usefulness of these advanced coherent Raman techniques in various coal gasifier environments, with emphasis on improving minority species detection and the precision of temperature measurements. Initial efforts have focused on the evaluation of Quasi-cw Stimulated Raman Gain Spectroscopy and Raman-Induced Deflection Spectroscopy. Performance testing and results are discussed. 6 figures.

36305 (DOE/METC—86/6069, pp 64-76) **Fiber optic instrumentation development.** Hensel, J.P. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Motivated by the potential of fiber optics and optical instrumentation, METC has initiated research dealing with the practical application of fiber optics and optical instrumentation of fossil energy processes with the goal of developing reliable, low-cost, on-line instruments for monitoring and/or controlling process conditions. This paper presents the results of four research investigations currently being pursued at METC. These are: 1) The Study of Nonisothermal Radiometry: applying pyrometry and optical radiometric techniques to nonisothermal targets, such as would be found in a coal-fueled combustor, to determine what temperatures, e.g., wall, gas, or particle temperatures, could be isolated by different types of pyrometers; 2) The Development of High-Temperature Fiber Optics: initiating work toward the development of sapphire fiber optics that could greatly ease optical access to fossil energy conversion processes; 3) The Study of High-Speed Optical Emissions: understanding the source of nature of the high-speed fluctuations seen by optical instruments in most coal-fueled processes; and 4) The Evaluation of Combustion Spectral Data: correlating optical emissions from a combustor with process conditions with the goal of future development of new, nonintrusive, process monitoring instruments or techniques. 16 references, 1 figure, 4 tables.

36306 (DOE/METC—86/6069, pp 117-124) **Advanced research in instrumentation and control technology: acoustic parameter studies.** Sheen, S.H.; Bobis, J.P. (Argonne National Lab., IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

In the process of developing acoustic/ultrasonic instruments for coal conversion and combustion processes, there is a need to understand various complex relations between acoustic parameters and physical properties of coal/gas and coal/liquid media so that the instrument readings and measurement accuracy can be evaluated and new sensing techniques can be developed. The primary objective of this project is to examine the theory and perform measurements of acoustic/ultrasonic parameters in such coal media. The acoustic parameters of interest are sound speed, attenuation, scattering pattern, and resonance scattering, which relate directly or indirectly to coal concentration, particle size and distribution, and rheological and thermal properties. In FY 1986, primary effort has been directed toward the development of a technique for attenuation measurement and use of the technique to determine the fluid viscosity effect on attenuation in various fluids and coal slurries. Based on the model analysis, acoustic attenuation in coal slurry results primarily from the viscosity effect, if one uses low-frequency acoustic waves. The goal of the present experiment is to quantitatively assess the viscosity effect on attenuation measurement. 8 references, 5 figures, 1 table.

36307 (DOE/METC—86/6069, pp 125-131) **In-situ particle characterization.** Giel, T.V. Jr.; Son, J.Y. (Univ. of Tennessee Space Institute, Tullahoma). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective is to evaluate particle sizing interferometer (PSI) signal characteristics and electronic circuit design to identify improvements of in-situ measurements of particle size and particle velocities. By identifying optimal PSI optical configurations and improved signal processors, the results will enhance capabilities for characterizing particles in hostile environments such as in coal combustors, scrubbers, and electrostatic precipitators. The present, first phase of the program is intended to analytically evaluate the many available PSI signals for particle size characterization, using Son's implementation of Pendleton's exact PSI Mie solution. Results to date are discussed. 16 references, 4 figures, 4 tables.

36308 (DOE/METC—86/6069, pp 132-145) **Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams.** Hadeishi, T. (Lawrence Berkeley Lab., CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Effective coal gasification can only be accomplished by monitoring products contained in the effluent gas stream. Ideally, concentrations would be monitored in such a fashion that operating parameters could be varied to optimize fuel production and pollution removal. Such analysis is difficult because of the presence of many species in a high temperature, high pressure stream. The purpose of this work is to use atomic line molecular spectroscopy (ALMS) to obtain real time concentration measurements in high temperature, high pressure environments. An instrument was constructed that would monitor hydrogen sulfide, carbon monoxide, carbonyl sulfide and correct for background absorption. The instrument and its performance are described. 5 references, 10 figures, 1 table.

36309 (DOE/METC—86/6069, pp 272) **Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer.** Romanosky, R.R. Jr.; Hensel, P.J.; Schaeffer, S.; Logan, R.G. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

A new (second-generation) alkali spectrometer has been designed, built, and tested. The Morgantown Alkali Fiber Optic Spectrometer (MAFOS) is capable of detecting total sodium and total potassium in process slipstreams at concentrations ranging from less than 1 part per billion to 80 parts per million. Since the MAFOS generates real-time (30-second intervals) alkali values over a wide concentration range, transient characterization as well as long-term alkali monitoring of either dirty or cleaned streams is possible. The monitor is based on a novel background correction technique, state-of-the-art fiber optic light transfer, and high-sensitivity photodioide signal detection. The sample enters the unit's high-temperature flame, which supplies energy to both decompose and excite the sample, which then emits light at the characteristic wavelengths of sodium and potassium. The resulting emissions are transferred by the fiber optic bundle to the detection system, where the signal is filtered, background corrected, and transferred to the data system. The data system processes and quantifies the signal and displays the results simultaneously on a video screen and a line printer. Laboratory testing of the MAFOS unit has been completed. The same-day reproducibility for sodium and potassium data generated over a wide concentration range as compared to the daily calibration curves was typically +/- 5% while day-to-day reproducibility was +/- 10%. Testing of the MAFOS unit on the Morgantown Energy Technology Center's pressurized coal-water combustor is underway. The MAFOS unit is being utilized to monitor the total sodium and total potassium at the combustor exhaust.

**36310 (DOE/PC/60015—44) Separation and characterization of coal derived components, 1 April 87-31 June 87.** Hurtubise, R.J.; Silver, H.J. (Wyoming Univ., Laramie (USA). Office of Univ. Research). 7 Jul 1987. Contract AC22-83PC60015. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012098.

Emphasis this quarter was on the interpretation of field-ionization mass spectral data for nitrogen compound fractions. Various correlations of chromatographic retention data for model compounds with ultraviolet spectral shift data were developed and evaluated.

**36311 (DOE/PC/70809—T14) Microbial screening test for lignite degradation: Quarterly progress report No. 10 for the period April-June 1987.** Yen, Teh Fu. (University of Southern California, Los Angeles (USA)). 1987. Contract FG22-84PC70809. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011831.

Optimization of sodium-methanol modification process was carried out. It was found that a longer reaction time and higher sodium dosage gave a higher yield of solubilized lignite. Incorporation of ethanol into solubilized lignite generated bioprecipitate. FT-IR analysis revealed the mechanism of precipitation and provided help to better understand the biodegradation process. Addition of acid solution to solubilized lignite promoted its separation into two fractions, which formed precipitate at pH 3.8 and 1.8 respectively. Benzene-methanol fraction of lignite was found to support the growth of the white-rot fungi S-1 which converted the solid benzene-methanol fraction into liquid products. Although there are no available detailed data about the bioliquid products from the benzene-methanol fraction of lignite, these products are expected to be organics of lower molecular weight than the original fraction. It is very possible that they constitute useful chemicals. Water-soluble fraction of lignite was separated by a dialysis membrane into a smaller fraction having a molecular weight of less than 3500. The dialyzed water-soluble fraction of lignite may be used as energy and/or carbon source for biological growth. 6 refs.

**36312 (DOE/PC/80537—T4) Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986.** Thorpe, A.N.; Senftle, F.E.; Mikesell, J.L. (Howard Univ., Washington, DC (USA). School of Engineering; Geological Survey, Reston, VA (USA)). 1986. Contract FG22-85PC80537. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010858.

To reproduce the natural environment as closely as possible, it was decided to construct a new hermetically-sealed borehole facility fabricated of fiberglass and plastic instead of steel. A large fiberglass drum was purchased from the Raven Corporation in Washington, Ohio. A 3 1/2 inch ID plastic tube to simulate the borehole was mounted along the central axis of the drum. The upper end of the tube was supported by a plywood ring and the lower end by a laminated bakelite support. Freshly mined bituminous coal (pea size) was specially trucked to the laboratory and placed in the drum as soon after removal from the mine as possible so that the moisture content did not change significantly. When filled, the drum was hermetically sealed with silicone rubber. An analysis of a representative sample was taken at the time of filling. To obtain some comparative information using fast neutrons (14 MeV) and $^{252}Cf$ neutrons ($\simeq$2.5 MeV), gamma spectra were taken with the (D,T) neutron generator and with a californium isotopic source. The experimental arrangement is shown. The neutron source or the generator target, as the case may be, was placed about 80 cm from the bottom of the coal canister. The germanium detector was placed outside the coal canister so that the germanium crystal was opposite the source and 22 cm from the outside of the canister. Counts were recorded with the californium source ($\simeq$85 $\mu$g) and also with the neutron generator, each for 45 minutes. The spectrum for each of the neutron sources is shown. The most obvious difference between them is the presence of the oxygen (n,n') photopeaks of full energy 6130 keV in the 14 MeV spectra but not in the spectrum made with californium neutrons. Some other interesting features are described.

**36313 (DOE/PC/80537—T5) Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986.** Thorpe, A.N.; Senftle, F.E. (Howard Univ., Washington, DC (USA). School of Engineering; Geological Survey, Reston, VA (USA)). 1986. Contract FG22-85PC80537. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010855.

As discussed in the last report, we are investigating the use of a neutron generator for borehole coal analyses. The neutron borehole probe uses a D-T (deuterium-tritium) accelerator tube called a Zetatron. The D-T accelerator tube emits bursts of 14 MeV neutrons due to the fusion reaction of deuterium with tritium. The Zetatron is a small D-T accelerator tube package with a high voltage pulse transformer called the TTA (tube-transformer assembly) as is shown in figure 1. Figure 2 shows an actual size drawing of the neutron generator tube. In the neutron generator tube deuterium ions are accelerated through a potential of 120 kilovolts and then collide into a metal target loaded with tritium. The fusion reaction resulting from this collision produces $^{4}He$ and fast neutrons at an energy of 14 MeV.

**36314 (DOE/PC/80537—T6) Use of generator produced neutrons in coal analysis: Quarterly report, March 15, 1986-June 15, 1986.** Thorpe, A.N.; Senftle, F.E.; Mikesell, J.L. (Howard Univ., Washington, DC (USA). School of Engineering; Geological Survey, Reston, VA (USA)). 1986. Contract FG22-85PC80537. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010856.

To study the use of a D-D neutron generator as a neutron source for gamma-ray spectroscopy in coal, we must place a D-D generator in service as soon as possible. Because of various administrative delays in purchasing a D-D TTA, it appears it will be some months before a D-D TTA assembly can be delivered. In the meantime, a D-D TTA has been borrowed from Sandia National Laboratory. Work is currently being done to recover a transformer from an old TTA to use with this tube. This arrangement will be useful for limited tests. In the meantime, measurements have been made in coal with 14-MeV neutrons using a D-T neutron generator. Certain limitations such as neutron burst repetition rate are evident. However, to increase the rate, a rapid technique to measure the relative neutron flux is required. A method using the gamma rays from the $^{16}O(n,p)^{16}N$ reaction looks promising. Tests show that this method can be used if $SnO_2$ is used as an oxygen source. As soon as the neutron counter is finished, work can proceed to increase the neutron burst repetition rate using this new method to measure the relative neutron flux as the electronics are adjusted.

**36315 (DOE/PC/80913—7) Biodegradation and bioconversion of coals by fungi: Technical report No. 7 for the period March 1, 1987-May 31, 1987.** Ward, B. (Mississippi Univ., University (USA). Dept. of Biology). 1987. Contract FG22-85PC80913. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011342.

We have screened fungal isolates derived from subbituminous and bituminous coals for activity on lignites and higher-ranked coals. We continued tests on methods of mild acid pretreatments of several coals to enhance biological activity. We continued testing three methods for long-term preservation of coal-solubilizing isolates.

**36316 (DOE/PC/90502—3) Catalyst accessibility in high volatile bituminous coal: Quarterly report.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). Jul 1987. Contract FG22-86PC90502. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011981.

During this quarter, progress continued on the determination of catalyst accessibility and the possible formation of hydrogen bonds in swellable pores of bituminous coal samples after the samples were subjected to swelling by appropriate solvents and variation in temperature. As reported previously, we are making use of an EPR technique recently developed in this lab involving nitroxide spin probes of different sizes, shapes and sites for hydrogen bonding.

36317 **(DOE/PC/90504—T3) Configurational diffusion of coal macromolecules: Quarterly progress report, March 15, 1987 to June 15, 1987.** Guin, J.A.; Curtis, C.W.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1987. Contract FG22-86PC90504. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011340.

This quarter we finished construction of the diffusion cell and made some preliminary runs using a sucrose-water solution. The cell appears to be functioning well, but more runs are needed to make a detailed analysis. This will be accomplished during the next quarter. We also are reporting some computer simulation results for solution of the material balance equations for the diffusion cell in the continuous flow mode. Details of the construction and preliminary diffusion experiments are presented in this report along with experimental results for sucrose-water runs. 6 refs.

36318 **(DOE/PC/90507—T3) Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987.** Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Jul 1987. Contract FG22-86PC90507. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012087.

The objective of this research program is to delineate the wetting characteristics of coal particles and to relate them to fine coal processing techniques. As both bulk and surface properties of coal are interrelated and have a controlling role on the performance of these processes, a detailed study was undertaken to correlate their influence on both the wetting behavior and response of coal to flotation. In the previous quarterly report, the effect of oxidation temperature on the wettability of different rank coals was discussed. The mean critical wetting surface tension, anti γ/sub c/, obtained from film flotation experiments of as-received and oxidized coals was correlated with the oxidation temperature and the oxygen content. It was found that anti γ,/sub c/ and oxygen content of all coals increase with the increase of oxidation temperature, indicating that coals are more hydrophilic as they become more oxidized and the oxygen uptake by the coals during oxidation is the main reason for the increase in hydrophilicity. Moreover, the results also show that the lower rank coals are more susceptible to oxidation than such high rank coals as anthracite. Research work during the past quarter involved continued characterization of bituminous coals subjected to various periods and degrees of thermal oxidation. The anti γ/sub c/ values for these coals, as obtained from film flotation experiments, were correlated with the oxidation time and oxygen content. A mathematical model of coal oxidation was developed and it was used to analyze the kinetics of coal oxidation. The experimental results were found to agree reasonably well with the mathematical model. Preliminary induction time measurements are presented in this report. 14 refs., 9 figs.

36319 **(DOE/PC/90519—T2) Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987.** Park, S.M. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90519. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010704.

We have been concentrating mostly on the electrolytic generation of humic acids in alkaline medium. When coal slurries are electrolyzed in alkaline medium, humic acids and carbon dioxide are produced at the anode and hydrogen gas is produced at the cathode. Humic acids are produced as intermediate species; the final oxidation product of carbonaceous materials is $CO_2$. Humic acids would have commercial values as a starting material for coal derivatization and as a soil conditioner in the Southwest region, where soil is alkaline. As pointed out, carbon dioxide is produced when coal is fully oxidized. Thus, studying optimum conditions, under which humic acids may be produced more efficiently, is important. Parameters affecting the oxidation of coal slurries that have been studied during this past quarter include: electrolysis temperature, pressure, and electrode potentials. The results are described in two sections, analysis of cyclic voltammetric results and product analysis. 5 figs., 1 tab.

36320 **Temperature dependence of the electron spin resonance spectra of a coal-derived vacuum distillation residue and components.** Castellano, S.M.; Chisholm, W.P.; Sprecher, R.F.; Retcofsky, H.L. (Pittsburgh Energy Technology Center, PA). *Analytical Chemistry;* **59**: No. 13, 1726-1731(1 Jul 1987).

Measurements of the intensities of the electron spin resonance (ESR) absorptions, in the g ~ 2 region of the spectrum, of the title materials were performed over a wide range of temperatures. Linear correlations of the measured intensities vs. the reciprocal of the absolute temperature were obtained. The regression lines have intercepts which are larger than the standard deviations of the measurements. This study shows that the intercepts arise from systematic errors in the measurements that introduce curvature into the plots. Two converging lines of research were followed: (a) a theoretical study of the effect of systematic errors on the outcome of ESR intensity measurements; and (b) repeated sets of measurements on two major fractions of the title materials. A complete analysis of all data shows conclusively that the materials of both fractions obey the Curie law exactly and that any observed deviation from this behavior lies within the range of systematic errors predicted by the theoretical study.

36321 **Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces.** Coe, J.M.; Lindberg, S.E. (Oak Ridge National Lab., TN). *Journal of the Air Pollution Control Association;* **37**: No. 3, 237-243(Mar 1987).

Particles deposited on leaves and inert surfaces during dry periods were examined with scanning electron microscopy to determine their morphologies and size distributions. Deposited particles were classified into two general types: spherical fly ash particles released during the burning of fossil fuels, and nonspherical particles (primarily soil material) consisting of both organic and mineral matter. Size distribution data indicated that deposition particle mass was dominated by particles larger than 10 microns in diameter, despite the fact that nearly 40 percent of the over 3800 particles analyzed were less than 2 microns in diameter. Our observations lend support to the hypothesis that a small fraction of the airborne particle population is responsible for an unproportionally large fraction of the dry deposited particle mass and that particle sedimention may be an important dry deposition process. 17 references.

36322 **Oxidation and coal structure.** Speight, J.G. (Western Research Institute, Laramie, WY). pp 183-206 of Coal science and chemistry. Volborth, A. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers (1987).

This chapter is a summary of the studies on the oxidation of coal with special attention being paid to those investigations that can be applied to defining the structural entities in coal. These studies have used reagents other than oxygen and oxidants such as nitric acid, permanganate, dichromate, peroxides and hypochlorites in investigating the structure of coal. 50 references.

36323 **New approaches to the characterization of lignites: a combined geological and chemical study.** Schobert, H.H.; Karner, F.R.; Olson, E.S.; Kleesattel, D.R.; Zygarlicke, C.J. (Univ. of North Dakota Energy Research Center, Grand Forks). pp 355-380 of Coal science and chemistry. Volborth, A. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers (1987).

Low-rank coals, lignite and subbituminous coal, are complex, heterogeneous substances which undergo a diversity of reactions often resulting in complicated mixtures of products. One of the characteristics of low-rank coals which serves, on a molecular level, to distinguish them from bituminous coals is the close association of some of the inorganic constituents with the organic structure. The most important consequence of the close interrelationship between the inorganic constituents and the organic structure is the low-rank coals cannot be characterized adequately by research which focuses solely on either the organic or the inorganic portion of the coal. Studies of both portions must be carried out in an integrated program to gain a proper understanding of the very complex material. This chapter illustrates this thesis with data from research

now in progress on characterization of the Beulah-Zap lignite, North Dakota. 39 references.

36324 **Host/guest structure concept and the thermolysis of coal.** Williams, J.M.; Vanderborgh, N.E.; Walker, R.D. (Los Alamos National Lab., NM). pp 435-459 of Coal science and chemistry. Volborth, A. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers (1987).

The interactions between the guest (minor) and host (major) components of coal are investigated by starting with a salient look at the current status of coal chemistry and coal formation. Results show that only small fractions of coal are extracted by non-reactive solvents below 100 C; reactive solvents, such as amines, extract significant amounts of material by degrading the host. Other results show that the pyrolysis of coal is characterized by five thermal events which are quantified and related to chemical events and energies of reaction. The aliphatic material in bituminous coals is demonstrated to be separate from the aromatic component up to the micron size and evidence for introduction by plants via triglycerides along with the bulk of the coal is presented. When coals are predominantly aromatic in nature, such as in the lignite - bituminous - anthracite coal series, aliphatic material is considered to constitute a significant portion of the guest component. The reverse is deemed true for carbonaceous materials that are predominantly aliphatic. 46 references.

## 0108 Waste Management

*REFER ALSO TO CITATION(S) 36242, 36283, 36307, 36474, 36760, 37151, 37606, 37611, 37669, 37670, 37849*

36325 **(BMFT-FB-T—86-131) Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report.** Kautz, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)). Dec 1986. 230p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770173.

The degree of industrial use of the annual 2,5 x 10/sup 6/ t fly ash from German hard coal fired power plants depends on their characteristics, i.e., their reactivity during the production of various products. The investigation indicates connections between fly ash characteristics and type of burned coal and firing equipment. The most decisive parameters are: grain size, grain morphology and CaO-content of a fly ash; they are influenced by the composition of the burned coal and the type of firing equipment. With 14 refs., 28 tabs., 32 figs.

36326 **(DOE/FE—0087) Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). May 1987. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010815.

The Gas Reburning-Sorbent Injection (GR-SI) process interfaces with the existing coal combustion systems to control nitrogen oxides by burning a lesser amount of coal in the boiler at a carefully controlled air to fuel ratio. Natural gas is then injected downstream of the coal combustion zone, where a portion of the NO/sub x/ is converted to nitrogen by the reducing conditions caused by the partial combustion of natural gas. Air is then injected downstream of the natural gas injection point to complete this staged combustion process. The net effect is to reduce NO/sub x/ emissions by approximately 60%. Sulfur oxides, primarily suffur dioxide are reduced in the process by injecting a sorbent into the upper part of the boiler or into the flue gas duct downstream of the boiler. The sorbent, now contained in the fly ash, is removed from the flue gas in an existing electrostatic precipitator or baghouse. The need for flue gas humidification will be determined on a site specific basis. While this space-saving technology is capable of reducing $SO_2$ up to 80%, one of the objectives of this study will be to achieve control at approximately the 50% level while burning a higher sulfur-content coal blend.

36327 **(DOE/PC/90514—T3) Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987.** Suidan, M.T.; Pfeffer, J.T.; Nakhala, G.F.; Traegner, U.K. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). Jun 1987. Contract FG22-86PC90514. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011218.

Anaerobic fluidized-bed GAC reactors have been proven successful for the treatment of biologically inhibiting wastewaters such as coal conversion wastewaters. However, in treating such wastewaters, which contain compounds that not only resist biodegradation but also inhibit the degradation of other compounds, adsorption on granular activated carbon (GAC) is a viable strategy for the removal of these inhibitory compounds. Since the adsorptive capacity of the reactor media is limited, partial replacement of the carbon bed is then necessary to maintain the concentration of inhibitory compounds below threshold levels. The cost of the GAC replacement thus represents a major operating cost of the system. The hydraulic detention time and the associated carbon inventory represents the single most important capital cost parameter. The objectives of this research are to determine, using experimental and modeling strategies, the effects of hydraulic detention time and the schedule of GAC replacement on the performance of fluidized bed GAC anaerobic reactors during the treatment of coal conversion wastewater. This objective is realized by the described activities.

36328 **(EPRI-EA—5115) Chemical form and leachability of inorganic trace elements in coal ash: Final report.** Wu, E.J.; Chen, K.Y. (University of Southern California, Los Angeles (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 202p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920467.

Both the electric power industry and the synthetic fuel industry face the need to dispose of increasingly large amounts of coal residues over the coming years. One potential problem is contamination of surfacewater and groundwater by trace elements as a result of leaching of residues. This study is centered on the effects of combustion parameters on chemical affiliation of trace elements in coal ash, as determined by successive fractionation extractions. The results indicate that combustion temperatures and the operating temperatures of emission control devices are significant controlling parameters affecting the percentage distribution of trace elements in coal ash. In most cases, for different coals burned in the same combustion unit under similar operating conditions, the percentage distributions of most chemical species were similar. Conversely, for different coals burned under different combustion conditions, no definitive distribution pattern of trace elements was indicated. Incomplete combustion may result in higher concentrations of leachable trace elements in coal ash. Coal with a lower heat content yields more leachable trace elements, possibly because of lower combustion temperatures inside the furnace. It was also found that for conventional combustion operations, hopper ash has a higher potential for leaching trace elements than bottom ash. The reverse is true for fluidized-bed combustion ash.

36329 **(LBL—23312) Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali.** Liu, D.K.; Chang, S.G. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 10p. (CONF-870802—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010740.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

We report herein the use of ferrous chelates of SH-containing amino acids including cysteine, penicillamine, N-acetylcysteine, and N-acetylpenicillamine in neutral or alkaline solutions for the combined removal of NO and $SO_2$ in wet flue gas clean-up systems. These SH-containing amino acids not only can stabilize ferrous ions in alkaline solutions to promote the absorption of NO, but are also capable of rapidly reducing ferric ions formed during the scrubbing process back to ferrous ions. The disulfide form of the above amino acids can be reduced by $SO_2$ and $H_2S$ to regenerate the starting monomeric species. The chemistry relevant to the absorption of NO by the above ferrous chelates and the ligand regeneration process will be discussed.

36330 **(LBL—23352) NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions.** Littlejohn, D.; Chang, S.G. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 7p. (CONF-870802—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010279.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Various cysteine derivatives were studied to determine if they would be superior to cysteine in removing NO from flue gas. These include glutathione (a tripeptide) and glyclcysteine (a dipeptide) which are the subject of this study. Glutathione (glutamylcysteinylglycine, abbreviated GSH) is a thiol compound that is abundant in living cells. It is composed of the amino acids glutamic acid, cysteine and glycine linked by peptide bonds. Cysteine is the central amino acid. In a manner similar to cysteine, GSH can be oxidized to the disulfide (noted as GSSG). Glyclcysteine is readily produced by the acid hydrolysis of GSH. It also forms a disulfide when oxidized.

36331 **(PB—87-175857/XAB) Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987.** Jozewicz, W.; Chang, J.C.S.; Sedman, C.B.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). Mar 1987. 31p. NTIS, PC A03/MF A01.

This paper discusses the development of new flyash/lime sorbents for removing $SO_2$ from coal-fired flue gas. Flyash/lime weight ratios of 1:1 to 10:1 and several additives to these sorbents for promoting their reactivity were evaluated in a bench-scale reactor simulating conditions in a fabric filter. Of the additives tested, $Na_2HPO_4.7H_2O$, $(NH_4)_2HPO_4$, and $H_3PO_4$ significantly enhanced the reactivity of the dry sorbents with $SO_2$. Alternative sources of silica were reacted with lime, and the resultant dry sorbents were shown to be highly reactive with $SO_2$. Of the siliceous materials tested, several diatomaceous earths, montmorillonitic clays, and kaolins were identified as containing reactive silica. The morphology of the sorbents developed was characterized. This information, along with the reactor test results, was used to rate the sorbents for pilot-plant evaluation.

36332 **(PB—87-179248/XAB) European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987.** Ellison, W.; Jones, J.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1987. 14p. (EPA—600/D-87/117). NTIS, PC A02/MF A01.

This paper gives updated details of major flue-gas desulfurization (FGD) and nitrogen oxide (NOx) control installations in the Federal Republic of Germany (West Germany) for coal-fired boilers. The paper reviews applicable government regulations limiting stack emissions, provides an understanding of the principal types of control system designs that have been applied, outlines technological advancements that have been achieved, and reviews experience gained to date in recent expanded use of FGD and NOx control facilities in Europe. Significant differences from FGD service and practice in the U.S. and Japan are described, and specific information is offered that may help improve the design, operation, and reliability of new and retrofit FGD installations in the U.S.

36333 **(PB—87-179974/XAB) Improvements in the methodology for measuring hydrochloric acid in combustion source emissions.** Cheney, J.L.; Fortune, C.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1984. 16p. (EPA—600/J-84/399). NTIS, PC A02/MF A01.

Pub. in Jnl. of Environmental Science and Health A19, No. 3, 337-350(1984).

A laboratory study was conducted to examine the interaction of gaseous HCl with glass and quartz media and with particles from coal-fired and incinerator boilers. Also, some source sampling results obtained by different methods at cement production plants, oil-fired boilers, and a coal-fired boiler were examined. On the basis of both studies, it is recommended that sampling for gaseous HCl in combustion source emissions employ a quartz filter medium, high-velocity sample flow, minimum filter temperature, and minimum sample volume. This approach is expected to yield the most-accurate HCl mass-emission rates for source categories having significant chlorine in fuels or processes.

36334 **(PB—87-182648/XAB) FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan.** Ando, J.; Sedman, C.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 6p. (EPA—600/J-87/014). NTIS, PC A02/MF A01.

Pub. in Power, Vol. 131, No. 2, 33-36(Feb 1987).

The paper discusses flue-gas sulfur dioxide ($SO_2$) and nitrogen oxide (NOx) control technology in Japan, where success in reducing $SO_2$ and NOx emissions in recent years has been quite remarkable considering Japan's economic growth and the increased role of coal in Japanese energy production. Yearly $SO_2$ emissions in Japan were reduced from from 5 million tons in 1967 to 1.2 million tons in 1985, while NOx emissions were reduced from 2 million tons in 1973 to 1.3 million tons in 1985. Conversely, Japanese energy use increased from about $3.0 \times 10^{15}$ kcal in 1970 to $4.0 \times 10^{15}$ kcal in 1985, during which time coal has become increasingly important. Fuel coal imports, which began in 1977, reached 20 million tons in 1985 and are expected to increase to 50 million tons by 1990.

36335 **(VTT-TIED—669) Trace metal removal from combustion gases.** Mroueh, U.-M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1987. 48p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752480.

This literature survey deals with alternative methods applicable for reducing heavy metal emissions released in fluidized bed combustion or gasification of fossil fuels, such as coal, heavy oil, and municipal and industrial wastes. The elements mercury, cadmium, lead, nickel, vanadium and zinc are the main concern of this study. Increasingly greater attention is being paid to heavy metal emissions from energy production because of the observation in the last few years of the enrichment of some metals into the fine particles. The detectably range of the existing particulate control devices is usually at this particle size. Most of the investigations aiming at the development of new methods for the reduction of heavy metal emissions are still in the initial stage. Because of the limited information available concerning the problem of heavy metals, this study deals also with some alkali metal removal methods, which possibly can give useful information. The emissions of heavy metals can be reduced, e.g. by binding them to compounds which can be removed from the flue gases. The predominant binding mechanisms are chemical and physical adsorption. Several natural aluminium, calcium and magnesium silicate materials can be used as chemical sorbents. They are also the least expensive of the sorbents. High surface alumina powders are possible physical adsorbents. The reactions between heavy metals and adsorbent can take place in the combustion zone of the fluidized bed reactor or the hot flue gases can be passed through a gas clean-up device, such as granular-bed filter, dry plate scrubber, or adsorbent-smoke reactor.

36336 **Applications of separations technology for the control of pollutants in advanced coal combustion systems.** Feibus, H. (Dept. of Energy, Germantown, MD). pp 131-153 of Chemical separations. Volume II. Applications. King, J.C.; Navratil, J.D. (eds.). Arvada, CO; Litarvan Literature (1986). (CONF-860411—).

From 1. international conference on separations science and technology; New York, NY, USA (15 Apr 1986).

The US DOE conducts a comprehensive research and development program to develop coal cleaning, flue gas cleanup, and combustion systems. The scope of the program is very broad, covering every stage of the coal utilization chain: pre-combustion, combustion, and post-combustion. The purpose of this paper is to discuss the applications of the separation technologies for each program, and to describe the major devices under development. Programs associated with each area of the coal utilization chain that are underway are: pre-combustion-coal preparation, gas stream cleanup for integrated gasifier combined cycle and molten carbonate fuel cell systems; combustion - fluidized bed combustion (atmospheric and pressurized), advanced combustors; post-combustion-flue

gas cleanup, gas stream cleanup for pressurized fluidized bed combined cycle and direct fired turbine systems. 1 reference.

## 0109 Environmental Aspects

*REFER ALSO TO CITATION(S) 36291, 36321, 36341, 36367, 36765, 37849*

**36337 (LMF—115, pp 14-19) Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier.** Chen, B.T.; Yeh, H.C.; Rivero, M.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The application of an improved virtual impactor was extended to a two-stage device. Experimental results confirmed that this device has the potential to be used as a quasi-monodisperse aerosol classifier. Both spherical and irregularly-shaped aerosols were used in this study. Data from dioctyl phythalate (DOP) aerosols showed the performance for a two-stage device could be predicted from a one-stage device, including the size distributions of the particles at the coarse, fine and intermediate (quasi-monodisperse) fractions. A good size classification was also found for fly ash, oil shale and talc aerosols. 1 reference, 4 figures, 2 tables.

## 0110 Reserves And Exploration

**36338 (STEV-TORV—87-5) New investigation method for the calculation of energy content of peatland by means of a radio wave probe.** Staffansson, H. (Statens Energiverk, Stockholm (Sweden)). 1987. 22p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752400.

In peat resource inventory, it is of great importance to determine several properties of peat. Water content, bulk density and energy content are usually determined by sampling and analyzing in laboratory. Since volumetric sampling is difficult and time consuming, these parameters often have been neglected. A radio wave probe (RVS) for in situ water content measurements recently has been developed at Helsinki University of Technology. The probe measures the dielectric characteristics of peat and relates the measured values to the dielectric constant. The portable field system consists of a probe that is pushed into the peat and electronic unit that stores measured data. The measurements then may be transmitted to a computer for further calculations or written out by a printer. The RVS makes it possible to get more reliable predictions in peat survey for industrial purposes and it is also a useful instrument for scientifical peat investigations. The equipment however needs further development towards a better technical function and better fitness for field conditions before it can be considered as a standard method in peat survey.

## 0120 Mining

*REFER ALSO TO CITATION(S) 36365*

**36339 (BC-TM-TCFE—547-DFS-86-3) Development of free-steered vehicles.** Spriggs, D.F. (British Coal, Stanhope Bretby. HQ Technical Dept.). [1987]. 18p. British Coal HQ Technical Dept. Library, Stanhope-Bretby, DE15 0QD, United Kingdom.

This project concerns the development of free-steered vehicles for use in British coal mines, and the design and manufacture of a prototype high capacity manriding vehicle capable of operating at speeds and at levels of passenger comfort not possible hitherto. The report covers the use of load-haul-dump vehicles, roadway repair vehicles, materials supply and manriding vehicles, as well as the problems encountered with diesel power pack reliability.

**36340 (IEA/ICTIS/TR—37) Water jet/jet assisted cutting and drilling.** Wood, P.A. (International Energy Agency Coal Research, London (UK)). Mar 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number TI87900799.

Information about the use and potential of water jet and jet assisted cutting and drilling equipment in underground coal mines is reviewed. The basic components of a high-pressure jet system are first discussed in order to determine the range and reliability of equipment needed. The hydraulics of a water jet and the interaction of a jet with the target material are next considered, illustrating current understanding of the mechanisms of jet formation and jet cutting. There then follows a review and discussion of those applications where water jet and jet assisted equipment has been tested for use in underground coal mining, evaluating successes and determining whether the perceived advantages of the technology are substantiated in practice. A section on health and safety-related aspects is rounded off by a brief statement of associated economic implications. It is concluded that water jet and jet assisted cutting and drilling have considerable potential for future use in specific underground coal mining applications, especially when used on roadheaders, drum shearers and drilling equipment. The main constraint on releasing this potential is the lack of a successfully developed sectoral control system.

**36341 (PB—87-183182/XAB) Hydrologic models of surface-mined areas. Technical report.** Rao, A.R. (Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Mar 1983. 44p. (PWRRC-TR—155). NTIS, PC A03/MF A01.

A review of the literature on hydrology of surface-mined areas reveals some problems related to data collection and to model development. The major problems in data collection arise from a lack of understanding of the hydrology of surface-mined areas. Even in undisturbed watersheds, parameters vary widely. Another problem is the representation of parameters so that they are of maximum use in models. Although the interaction between field measurements, proper representation of field data, and types of models used in surface-mining hydrology is clear, these aspects have been treated separately thus far. Because of the variability in the hydrologic properties in these surface-mined areas and the changes in these over time, the data acquisition and modeling of surface-mined areas should be considered together for optimal solutions of problems related to both.

**36342 (PB—87-188751/XAB) Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986.** Timko, R.J.; Kissell, F.N.; Thimons, E.D. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 23p. (BM-IC—9109). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 86-600132.

The Bureau of Mines used sulfur hexafluoride ($SF_6$) tracer gas to evaluate the effectiveness of gob ventilation and/or sealing practices at three coal mines, each having different problems associated with their mined-out areas. The purpose of these ventilation studies was to better understand whether current techniques employed for ventilation or sealing are successful at minimizing the potential for gob fires and explosions. The work performed at each mine is discussed: one is a longwall operation that uses ventilation to carry off hazardous gases, and two are room-and-pillar operations, each with far different concerns, that seal off the gobs to isolate them from the main mine ventilation. In all cases, employment of the Bureau's $SF_6$ tracer gas technique resulted in answers to questions raised by the mine operators concerning the effectiveness of their gob ventilation or sealing practices in preventing mine fires.

**36343 (PB—87-189817/XAB) Thick-seam mining in the Western United States--geological considerations. Information Circular/1986.** Boreck, D.L. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1986. 25p. (BM-IC—9116). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 86-600298.

Thick coal seams are common in the Western United States. Many seams are over 50 feet thick and are too deep to extract using surface methods. Currently, such deposits are developed using standard Eastern mining methods which only extract a few feet of total seam thickness, often rendering the remaining coal unminable with current technology. Novel methods that increase thick-seam recovery have been developed and are currently being used in Europe. These methods--high-face single-pass and multislice longwall, longwall caving, and hydraulic mining--have great potential for use in the United States. Their use requires, among other things, a full evaluation of geologic features common to thick coals.

The objective of the report is to present and summarize those features that will affect the introduction of the methods into thick-seam mines in the Western United States.

36344 **(STEV-TORV—87-6) Combined systems sod peat - milled peat.** Sauli, J.; Jonsson, E.; Teljing, Aa. (Statens Energiverk, Stockholm (Sweden)). Feb 1987. 67p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752404.

One of the purposes of this study, is to study how much milled peat a producer can get between and right after the sod peat harvests. The purpose of the study is also to identify the effect on the drying of the sod peat if the producer harvests the milled peat harvest or not. Finally a subordinate purpose of the study is to see how differences in the raw peat quality affect the production result when all other conditions are the same. On condition that the milled peat can be sold to a price of 75 SEK/MWh at the bog, the difference between the marginal cost for milled peat production between and right after three sod peat harvests are the following: 1. There is always a positive margin on harvesting the milled peat without separate milling between the sod peat harvests if pneumatic, harvester, and tractor capacity is available so that no investments have to be made. 2. If the producer has got tractor capacity but has to make an investment in a new pneumatic harvester, it takes 40 hectares of production area to have a positive margin on the combined sod-milled peat production if there is no milling between the sod peat harvests. If the producer has to make investments in a new tractor and a new pneumatic harvester it takes 120 hectares of production area to have a positive margin on the same conditions as above. 3. To have a positive margin it is likely that the demand for a specific production area decreases compared to the figures under point 2 above, if the producer invests in a miller and harrow to produce more milled peat between the sod peat harvests. 4. We have seen no positive or negative effects on the drying of the sod peat if the milled peat is harvested between the sod peat harvests or not. 5. The quality of the raw peat within the test area, which still is good enough for sod peat production, affects the energy content per m/sp3/ sod peat by a factor of two.

36345 **(STEV-TORV—87-7) Hydrogeological studies of peatlands at Haerjedalen.** Staffansson, H. (Statens Energiverk, Stockholm (Sweden)). Feb 1987. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752405.

The Department of Quaternary Geology, University of Uppsala, started 1985 a research project in cooperation with the peat-production project in Sveg. The reasearch project deals with several subprojects. This report summarizes the first period of the subproject hydrogeological studies of petlands. The report is mainly devoted to the study of bulk density variation in peatlands and also gives a brief description of the obtained results of the hydrological studies. The result show that bulk density variations are caused by the peat type, humification degree and the hydrogeological circumstances. The run-off water is concentrated to the surface it the peatland is sloping. The underlaying peat then often has a high bulk density and therefore low hydraulic conductitvity. If the peatland is very flat water is stored and concentrated if the peatland type is soligenous. Then the bulk density in the underlaying peat often is low which gives high hydraulic conductivity and groundwater run-off. Because of this, the bulk density content per area is not directly correlated to the depth of the peat. By measuring the bulk density in several spots on the peatland it is possible to construct a map over the bulk density content per area unit. This map can be useful in production planning and estimations over how many years peat production is possible.

36346 **Effects of accurate MS delays on productivity, energy consumption at the primary crusher, oversize, ground vibrations and airblast.** Chiappetta, R.F.; Burchell, S.L.; Reil, J.W.; Anderson, D.A. (Atlas Powder Co., Subsidiary of Tyler Corp., Dallas, TX 75248-4629). pp 213-240 of Proceedings of the twelfth conference on explosives and blasting techniques. Konya, C.J. Montville, OH; Society of Explosives Engineers (1986). (CONF-8602104—).

From 12. conference on explosives and blasting technique; Atlanta, GA, USA (9 Feb 1986).

A total of 26 full-scale production blasts at three sites were extensively monitored with sophisticated instrumentation systems to determine the benefits of more accurate detonators. The new and more accurate MS electric Masterdet detonator was tested against conventional detonators to determine any increase in productivity outputs. All blast design parameters between paired blasts were kept as constant as possible with the only difference being the inherent accuracy of both detonator systems. Blasts designed with the Masterdet detonators resulted in ground vibration reductions up to 56%, energy consumption at the primary crusher by up to 28% and oversize was reduced by up to 82%. No direct correlation was found in the reduction of airblast and accurate detonators. It was also determined that the Masterdet could withstand twice the acceleration levels and pressures from the effects of adjacent detonated boreholes without adverse results on the function time and reliability, when compared to conventional electric and nonelectric detonators in a rugged production environment.

## 0130 Transport And Handling

*REFER ALSO TO CITATION(S) 37563*

36347 (DOE/METC—86/6069, pp 254-266) **Reduction of erosion in elbows due to flow field modifications.** Johnson, E.K.; Means, K.H.; Eyler, R.L.; Holtzworth, J.D. (West Virginia Univ., Morgantown). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC21-84MC21349.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

Coal and other solids are commonly transported through pipes as a gas-solids mixture. Pneumatic transport systems usually contain at least one elbow in the flow path. The erosion that occurs in these devices presents problems in both the design and operation of these transport systems. State-of-the-art solutions to this problem include: 1) the use of a blind-tee instead of a bend, which accumulates material to protect surfaces, 2) selection of more wear-resistant materials, 3) employing sacrificial material, and 4) altering the design conditions by varying the gas velocity and/or solids loading. To date, each of these options is only a partial solution to the problem. The purpose of this study is to investigate the potential for modifying the flow field within an elbow in order to reduce the erosion rates. Conceptually, jets would move the eroding particles away from the surfaces where the erosion rates are normally the greatest. Also, the particles would be given additional momentum, directed downstream of the bend, thus reducing the pressure drop and acceleration length associated with a standard bend. Because of the lack of knowledge concerning gas-solids mixtures flowing in bends, this study was formulated in two parts. Part I was an exploratory study to determine if the concept had any merit. Part II is intended to produce more detailed information if the results of Part I warranted further study. The results of Part I are discussed. Part II commenced July 1986. 1 reference, 9 figures.

36348 **(PB—87-183216/XAB) Characterization, renovation, and utilization of water from slurry-transport systems.** Manahan, S.E. (Missouri Univ., Columbia (USA). Dept. of Chemistry). 30 Sep 1982. 22p. NTIS, PC A02/MF A01.

Laboratory studies indicated that water of impaired quality could be purified en route in a coal-slurry pipeline, taking advantage of the long contact time and high mixing rate. Upon arrival at a powerplant, the slurry would be burned, destroying the organics or retaining them with the coal ash. Purified water could be reclaimed. A coal-gasification apparatus was used to prepare water contaminated with organic byproducts, nonactivated char, and coal ash. Removals of heavy metals (Cu, Ni, Pb, Cd, and Zn) were greatest (94-100%) with aged coal (surface oxidized).

36349 **(PB—87-189676/XAB) Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987.** Robinson, C.W. (Energy Transition Corp., Santa Fe, NM (USA)). Apr 1987. 79p. NTIS, PC A05/MF A01.

The study was composed of three tasks: a combustion test of char and a char-oil-water slurry (CHOWS) produced from San Juan Basin coal at the Pittsburgh Energy Technology Center in

January 1985, a transportation study of a CHOWS movement through the Four Corners Pipeline from the San Juan Basin to Los Angeles, California, a pyrolysis test of raw and hydrothermally-cleaned San Juan Basin coal to determine whether hydrothermal treatment would improve the quality and quantity of the oil produced from the coal. The pipeline study concluded that CHOWS cannot compete on a delivered energy basis with no. 6 Residual fuel oil at its current price of approximately $18.50/barrel. The pyrolysis tests showed that San Juan Basin coal, when beneficiated by the Battelle Hydrothermal Process, holds promise of improving the overall oil yield.

36350 **Pneumatic transport of coal by steam.** Ekmann, J.M.; Wildman, D.J.; Mathur, M.P.; Klinzing, G.E. New York, NY; American Institute of Chemical Engineers (1985). 19p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Steam has been suggested as the transport gas in power plant facilities where the availability high pressure steam already exists. The transport of coal pneumatically by the use of steam to a loading ratio of 10 has been studied experimentally in a 0.0107 meter diameter pipe. Analysis of the energy losses in transport of the steam-coal mixture has been carried out using a model based on thermodynamic and fluid mechanics principles. Good agreement between the data and model has been obtained.

## 0140 Combustion

*REFER ALSO TO CITATION(S) 36242, 36300, 36303, 36305, 36307, 36309, 36335*

36351 **(CONF-870540—1) Materials for FBC [fluidized-bed combustion] air heater applications.** Natesan, K.; Miller, S.A.; Podolski, W.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02. File Number DE87011422.

From 9. international conference on fluidized bed combustion; Boston, MA, USA (3 May 1987).

The US DOE-sponsored Atmospheric Fluidized-Bed Cogeneration Air Heater Experiment (ACAHE) is intended to assess the performance of various heat exchanger materials in order to establish confidence in the resultant designs of fluidized-bed combustion (FBC) air heater systems. Westinghouse Electric Corp. is preparing specifications and hardware for the ACAHE. Argonne National Laboratory (ANL), through a contract with the Rocketdyne Division of Rockwell International, will conduct the tests in the DOE 6-ft by 6-ft AFBC facility in El Segundo, California. This paper presents a brief overview of the project, followed by a summary of the materials assessment work at ANL. Pertinent high-temperature materials exposure data and a possible corrosion mechanism in FBC's are discussed. Results from laboratory-scale corrosion experiments are then presented. These tests, have provided corrosion information on a variety of ASME-coded and noncoded structural materials, coatings, claddings, and weldments under a well-characterized laboratory test environment simulating the atmosphere in an FBC. 35 refs.

36352 **(CONF-870540—2) Erosion calculations in a two-dimensional fluidized bed.** Lyczkowski, R.W.; Bouillard, J.X.; Berry, G.F.; Gidaspow, D. (Argonne National Lab., IL (USA); Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011419.

From 9. international conference on fluidized bed combustion; Boston, MA, USA (3 May 1987).

Erosion in fluidized-bed combustors, a nearly commercial means of burning coal cleanly, has surfaced as a serious issue that may negatively affect their economics. The evidence suggests that the key to understanding this erosion is detailed knowledge of the coupled and complex phenomena of solids circulation and bubble motion. The FLUFIX computer code has been developed for this purpose. Computed hydrodynamic results compare well with limited experimental data (including the bubble frequency and size and the time-averaged porosity distribution) taken in a thin two-dimensional rectangular fluidized bed containing a rectangular obstacle. The monolayer energy dissipation erosion model is developed and shown to generalize the so-called power dissipation erosion model used successfully to analyze slurry jet pump erosion. The computed transient and time-averaged transient energy dissipation rates for the monolayer energy dissipation and Finnie erosion models are compared. The computed erosion rates are compared with each other and with available literature erosion data to validate the calculations. The results are in reasonable agreement. More erosion experiments are needed to further validate the computations. 29 refs.

36353 **(DOE/FC/10627—2363) Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987.** Austin, L.G.; Conn, R.E. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Jun 1987. Contract AC21-85FC10627. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012183.

The objective is to investigate adherent ash deposits and slag initiation as related to utility boilers for selected low-rank coals. Martin Lake and Wildcat lignites (Texas) were ion-exchanged with ammonium acetate. The amount of ASTM ash (dry basis) was reduced from 12.9 to 8.6 wt % for Martin Lake and from 11.1 to 7.2 wt % for Wildcat lignite. The amount of exchangeable sodium and calcium were found to be 97% and 65%, respectively for Martin Lake and 68% and 72% for Wildcat lignite. The gas-fired drop tube furnace was used to produce ash deposits with untreated and ion-exchanged Martin Lake and Wildcat lignites at conditions similar to those of a boiler radiant section (slagging). The hot zone temperature was held at 1500°C and the constrictor temperature was held at 1300°C for these tests. The estimated particle residence time in the hot zone of the furnace was less than two seconds. Both Martin Lake and Wildcat lignites showed high slagging potential in the test furnace. For a 20 minute test period, the ash sticking fractions were 0.61 and 0.71 for Martin Lake and Wildcat, respectively. The deposits from each of the lignites were highly fused and had maximum strengths (at the top) in excess of 5 M Pa. The ion-exchanged lignites had ash sticking fractions which were similar to those of the untreated lignites. However, removal of Ca, Na and Mg lowered the maximum strengths of the Martin Lake and Wildcat deposits to 1.4 M Pa and 1.2 M Pa, respectively.

36354 **(DOE/MC/23249—2360) Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986.** Kono, Hisashi O.; Huang, Ching-Chung. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Jan 1987. Contract AC21-86MC23249. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012048.

The development of technique measuring kinetic forces of solid particles in fluidized beds has been achieved by using the tracer particle method. The measurement method using Piezotron sensor was also initiated. The information obtained by the various measuring techniques, including tracer particle, Piezotron, and strain gauge gives different physical meaning. Using the tracer particle technique, the correlations among the durable compressive strength, tensile strength, and durable impact energy were experimentally verified. The kinetic forces of solid particles (dp = 0.5, 1.0, 2.18 mm) in the 10.8 cm fluidized bed (H/D/sub t/ = 1, 2, 3) at various gas velocities were measured. The kinetic forces of solid particles (dp = 1.0 mm) in the 10.8 cm spouted fluidized bed were also measured and shown to be higher than those in the conventional fluidized bed. 3 refs., 8 figs.

36355 (DOE/METC—86/6069, pp 5-12) **In situ real-time analysis of particulates.** Ottesen, D.K. (Sandia National Labs., Livermore, CA). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The goal of this project is the development of optical analytical techniques for the real time measurement of particulate fuel characteristics in combustion environments. The study focused on the determination of particle size and velocity using light scattering techniques, and the elemental analysis of individual particles by laser spark spectroscopy. The research has led to the development

of an in situ particle sizing system utilizing He-Ne and Ar ion lasers to generate scattered light signals from coal particles entrained in a nitrogen flow. Data reduction is based on calibrations using particles of known size and precision, and produces values of size and velocity for single particles. The in situ determination of particle composition is accomplished using a high power Q-switched ND:YAG laser which rapidly heats a particle producing a laser spark. Particles investigated consisted of: water droplets of uniform diameter containing known amounts of dissolved NaCl, and raw particles of a Kentucky bituminous coal which had been pulverized and classified into different size fractions. Results to data are discussed. 5 references.

36356 (DOE/METC—86/6069, pp 100-116) **Ash deposition sensor development.** Fasching, G.R.; Smith, N.S.; Keech, T.W. Jr. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The goal of this project is the development of deposition and deposition rate sensors capable of in situ, real-time measurement of deposition that occurs in fossil energy process streams. Based on pre-FY 85 development, three sensor system concepts, the heat flux sensor, the dual-pendulum sensor, and the surface acoustic wave sensor, respectively, are at different stages of development. To meet the goal, the project objectives for FY 86 are; the heat flux sensor prototype that is well characterized will be tested in the coal water fuels (CWF) combustor; the dual-pendulum prototype will undergo deposition test facility characterization; and the surface acoustic wave (SAW) technique prototypes will be conceptually tested. The results to date on a laboratory scale and process sidestream flow test of a heat flux sensor method, and the results to date on research and development of dual-pendulum and SAW sensing techniques are discussed. 7 references, 16 figures.

36357 (DOE/METC—86/6069, pp 276-277) **Deposition effects in pressurized combustion of coal-derived fuels.** Anderson, R.J.; Woodruff, S.D.; Dennis, R.A.; Ross, J.S. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The objective for these deposition studies is to provide a fundamental understanding of phenomena related to the formation of inorganic deposits on gas turbine/heat engine components and to develop a predictive capability for associating fuel contaminant chemistry and heat engine operating conditions with deposit formation. Well-characterized coals, coal ashes, or minerals are entrained by a carrier gas into the reactor where they are exposed to conditions similar to those encountered in a combustion gas turbine or diesel engine. After combusting and/or thermal conditioning, the particles exist the reaction through an acceleration nozzle at high velocity. The nozzle jet impinges onto a temperature-controlled target of specific geometry where deposition tendencies of the test particles are measured. One method of determining the key contaminants in coal which promote deposit formation is the use of model compounds. Several homoionic clays based on montmorillonite have been prepared to study the influence of specific single elements on deposit formation. A second reactor, the combustion deposition entranted reactor (CDER), has been designed and built. The design of the CDER includes capabilities for operating at pressure up to 11 atmospheres, optical access ports to allow nonintrusive characterization of both the reaction and target zones; an extractive, quick-quench sampling probe; and a cooled injection probe with variable positioning to obtain variable reaction zone residence times. A variety of instrumentation including a newly developed multimonitor will be used to characterize the reaction and target zones of the CDER.

36358 (DOE/METC—86/6069, pp 278) **Laser-induced fluorescence detection of mineral vaporization species.** Casleton, K.H.; Kanosky, J.P.; Gase, W.J. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The overall goal of this project is to investigate the vaporization behavior of mineral species found in coal, and to determine the kinetic rates of these processes for use in coal, and to determine the kinetics rates of these processes for use in developing predictive models of the fate of coal ash during and subsequent to combustion. Vaporization experiments utilize samples of pure oxides, such as CaO, MgO, and $SiO_2$, representative of coal mineral components which have been observed in enriched concentrations in combustion-generated submicron aerosol fumes. These samples are heated to reaction temperature in a resistively heated oven. Once the sample reaches the desired temperature, CO is passed over it, and the reduction of the oxide by CO is monitored by detection of Ca vapor downstream via laser-induced fluorescence. Laser-induced fluorescence potentially offers a very sensitive and specific method for detection of high-temperature metal vapors such as Ca and Mg, but can be strongly influenced by processes which depopulate the excited state of the optical transition. Thus, processes such as fluorescence quenching, potential enhancement of excited state reactivities and radiation trapping at high number densities have been examined for possible effect on linearity of the detected fluorescence signal. In addition, the processes to be studied are heterogeneous in nature, and involve component steps such as adsorption, reaction at the surface, and desorption of reaction products. In order to better understand the initial phases of the gas-surface reaction, X-ray photoelectron spectroscopy (XPS), a surface-sensitive technique, has been used in an effort to identify adsorbed species on CaO.

36359 (DOE/METC—86/6069, pp 280) **Imaging and control instrumentation for studying the combustion behavior of single fuel droplets.** Maloney, D.J.; Lawson, L.O.; Fasching, G.E.; Spann, J.F. Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—).

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

To better understand the combustion behavior of liquid and slurry fuels, the behavior of single fuel droplets are being studies. Experiments are performed in an electrodynamic balance apparatus in which single-charged droplets are balanced at the null point in an applied ac field. To facilitate experiments in the electrodynamic balance, instrumentation has been developed which enables the continuous rebalancing of droplets at the null point while monitoring changes in droplet size, mass, and density resulting from evaporation of water or other volatile fuel components. The droplet imaging system (DIS) utilizes a Newvicon detector (extended IR video detector) to monitor droplet position and size. Droplets are backlit with a partially collimated light-emitting-diode source and a shadow image is projected onto the video detector. Each video scan is transferred to a microprocessor and image analysis techniques are employed to determine the cross sectional area and location of the droplet. A control signal is then generated which maintains stable droplet positioning at the balance null point by adjusting an applied dc field. The magnitude of the control signal is proportional to the droplet mass so that, for each video scan, the DIS generates information on droplet mass as well as size. The 95% confidence interval for droplet size is within +/- 2 microns for droplets ranging from 50 to 200 microns in diameter. The confidence interval for droplet mass is within +/- 50 nanograms. The DIS has been utilized in an experimental program to determine the heating conditions required to achieve explosive boiling and secondary atomization of coal-water fuel droplets under simulated combustion conditions.

36360 (DOE/PC/70765—9) **A program of basic research on the preparation and stability of coal/water slurries: Final report.** Atlas, H.; Casassa, E.Z.; Povirk, C.A.; Toor, E.W. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering). 31 Mar 1987. Contract FG22-84PC70765. 416p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE87007689.

The dry powder of each coal was characterized as to its median size, particle size distribution, B.E.T. surface area with nitrogen as adsorbate, degree of oxidation determined by an alkali extraction test, density in water, critical surface tension for wetting and wettability in solutions of three surfactants. Microelectrophoretic mobility in dilute suspensions and electrophoretic mobility of 50%(wt) slurries were determined as a function of pH. Apparent

viscosity of 50%(wt) slurries was measured as a function of pH, and apparent viscosity and sedimentation behavior were determined as a function of coal concentration at the natural pH of each coal. Sedimentation behavior was also observed as a function of pH. It was confirmed that the DLVO theory for dilute suspensions of charged colloidal particles can be qualitatively applied to concentrated suspensions of coal in water. Extensively oxidized coals have high surface charge and are well dispersed suspensions at all pH, with low viscosity, high maximum solids but poor sedimentation stability. Coals which produce high ionic strength slurries are extensively flocculated in a secondary minimum at all pH, even at low coal concentrations, and have good sedimentation stability, low maximum solids, and high viscosity at low shear rates. Unoxidized coals with low ionic strength slurries become weakly flocculated at high coal concentration at pH's near a point of zero charge, but are well dispersed at other pH's. Very low ash coals have a single point of zero charge near pH 7, but the behavior of higher ash coals has a more complex pH dependence. Most high ionic strength slurries are produced by high ash coals, but not all high ash coals produce high ionic strength slurries. Very low ash coals and coals with low median size are also susceptible to hydrophobic aggregation unless wetting agents are used. 63 refs., 190 figs., 130 tabs.

**36361 (DOE/PC/90275—T4) Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987.** Rini, M.J.; LaFlesh, R.C.; McGowan, J.G.; Beer, J.M.; Toqan, M.A.; Yu, T.U. (Combustion Engineering, Inc., Windsor, CT (USA)). 1987. Contract AC22-86PC90275. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009064.

The objective of this two year project is to develop a High Efficiency Advanced Coal Combustor (HEACC) for retrofit to existing boilers currently firing oil or natural gas. The program will develop a retrofitable suspension firing system that is adaptable to the use of ultrafine coal-water fuel (with and/or without, alkali sorbent) or dry ultrafine coal. The maximum potential of the ultrafine CWF will be realized by employment of the technique of "secondary atomization." The project is divided into five technical tasks: Cold Flow Burner Development; Pilot Scale (5 x $10^6$ Btu/hr) Testing at the Massachusetts Institute of Technology (MIT); Demonstration Scale (50 x $10^6$ Btu/hr) Testing at Combustion Engineering (C-E); Data Analysis and Final Report; and Project Management.

**36362 (ORNL/TM—9821) Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study.** Smith, O.L. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011970.

A first-principles model of a nominal 20-MW atmospheric-pressure fluidized-bed coal combustion (AFBC) power plant was developed to provide insight into fundamental dynamic behavior of fluidized-bed systems. The control system included major loops for firing rate, steam pressure and temperature, forced and induced draft air flow, $SO_2$ emission, drum water level, evaporator recirculation, and bed level. The model was used to investigate system sensitivity to design features such as the distribution of heat transfer surface among the bed boiler and superheater and the out-of-bed superheater. Also calculated were the sensitivities of temperatures, pressures, and flow rates to changes in throttle, attemperator, and feedwater valve settings and forced and induced draft damper settings. The large bed mass, accounting for ~40% of the active heat capacity, may vary under load change and could impact controller tuning. Model analysis indicated, however, that for the design studied, the change in bed mass does not appear to significantly affect controller tuning even if the bed mass varies appreciably under load-following conditions. Several bed designs are being considered for AFBC plants, some with partitions between bed sections and some without, and these differences may significantly affect the load-following capability of the plant. The results indicated that the slumping mode of operation can cause distortion of the heat source/sink distribution in the bed such that the load-following capability (rate of load change) of the plant may be reduced by as much as a factor of 5 compared with the mode in which tube surface is exposed. 9 refs., 13 figs., 6 tabs.

**36363 (TKK-KO/ET—19) Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat.** Huhtinen, M.; Peltola, T.; Sarnes, P.; Jahkola, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). Oct 1986. 105p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752376.

The purpose of this study was to compare design and dimensioning information collected from literature with results of laboratory tests of continuous steam fluidized bed dryer for milled peat. The special topic of study was the influences of different bed materials on heat transfer and hydrodynamics of steam fluidized bed. The tests were carried out with peat, sand and magnetite. The smaller the particle diameter of bed material, the better coefficient of heat transfer between bed and immersed heat exchanger can be achieved. By using magnetite bed ($d=0.37$ mm) the coefficient of heat transfer was two times greater than with peat bed. On examining separation of dry peat and bed material, it turned out that magnetite was more favourable than sand. By using a magnetic separator to separate magnetite and dry peat better separation was achieved than by using air classifier for sand and peat. On the other hand it was found out that dry peat and bed material can be separate already in the bed by stratification when fluidization velocity is near a minimum and particle diameter of bed material is large enough. Under such circumstances, the lighter peat segregates on the top of the bed. The results from test runs were used to design steam fluidized bed dryers with three different bed materials for drying of milled peat at a district heating power plant. According to the calculation the use of separate bed material of small enough particle diameter ($d<0.5$ mm) increases profitability of the dryer because of the fact that both investment and operational costs are then decreased. After the test runs reported here, a closed steam circuit has been added to the pilot steam fluidized bed dryer. It is now possible to use water vapour from dryed material as fluidizing medium as it is intended to do in commercial full scale dryers.

## 0150 Marketing And Economics

*REFER ALSO TO CITATION(S) 36949, 36978, 36984, 36987, 36988, 36989, 36990*

**36364 (DOE/PC/62700—T10) Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report.** (Holt Associates, Inc., Fairfax, VA (USA)). 31 Mar 1987. Contract AC22-83PC62700. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012201.

The Coal Evaluation Model (CEM) has been designed to allow the user to estimate the costs associated with different mine-to-market coal use scenarios under a variety of technical and economic constraints. This has been accomplished by establishing an algorithm which provides for a series of functional elements which can be linked together in various combinations depending upon the market objectives and limitations assumed by the user. These include the ability to separate the raw coal from its associated impurities as defined by its unique washability analyses and subject the beneficiated product to a variety of optional process, steps, culminating in a computation of the estimated cost of each link. By selectively including links, the user has the capability to evaluate a broad spectrum of conceivable mine-to-market scenarios. At the core of the CEM is a sophisticated data management system which permits the user to establish a coal washability library holding thousands of records, each having as many as five separate size fractions. These data can be easily recovered and manipulated according to product quality or separation efficiency criteria to define a theoretical feed for shipment direct to market or to subsequent process steps. This feed can be raw or beneficiated depending upon the nature of the scenario being defined and the availability of coal data. At the user's option, this coal feed can be incorporated into a coal use scenario which may include conventional physical preparation, advanced preparation, pelletization, and/or slurry production. Besides serving as a convenient means for managing large volumes of coal washability data and making rapid estimates of the costs associated with reasonably elaborate mine-to-market coal use scenar-

ios, the CEM can be an efficient tool for performing sensitivity analyses.

36365 **(PB—87-183489/XAB) Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations.** Retherford, R.M.; Hinderman, T.K.; Hawley, C.C. (Alaska Dept. of Natural Resources, Fairbanks (USA). Div. of Geological and Geophysical Surveys). Dec 1986. 45p. (RI—86-13). NTIS, PC A03/MF A01.

Contents include: significant findings; market demand; geology, mining plan; coal handling and transport; power plant; electrical transmission; estimated cost of electricity.

### 0160 Health And Safety

36366 **(PB—87-171377/XAB) Wood crib fires in a ventilated tunnel. Report of Investigations/1986.** Egan, M.R.; Litton, C.D. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 25p. (BM-RI—9045). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 86-600181.

The Bureau of Mines report presents results from experimental studies on wood crib fires in an intermediate-scale fire tunnel. Gas concentrations, smoke-particle characteristics, heat release rates, and ventilation rates were determined. These measurements form a data base for wood, which can be used with previous analyses for coal and future studies of other mine combustibles, to comprehend the potential hazards of these materials in underground-mine fires. A knowledge of the combustion products emitted from these materials will benefit fire detection and control. Results show the changes in burning rate and heat release rate produced by different crib configurations and ventilation rates. Also included are the effects that the burning rate has on smoke characteristics and gas production.

36367 **Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials.** Gray, R.H.; Massey, M.J.; Fillo, J.P.; Drucker, H.; Craun, J.C.; Reilly, C.A.; Renne, R.A.; Wilson, B.W. (Pacific Northwest Lab., Richland, WA 99352). pp 61-70 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—). Contract AC06-76RL01830.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Over the last decade, a substantial data base has been developed concerning the physical, chemical and toxicological properties of coal conversion (liquefaction and gasification) materials. This work has evaluated products and byproducts obtained from processes that, in many cases, were operated under a variety of conditions and configurations. We have recently completed a major effort to compile, integrate and evaluate the chemical, physical, toxicological and engineering database that has been developed. The effort has involved several laboratories, organizations, and individuals. This paper summarizes the results of this effort soon to be published in book form, and indicates those properties/characteristics (i.e., boiling point and degree of aromaticity) of coal conversion materials that most directly relate to toxicological effects. Toxicological endpoints discussed emphasize mutagenic and carcinogenic responses.

## 02 PETROLEUM

### 0201 Reserves

*REFER ALSO TO CITATION(S) 36381*

### 0203 Drilling And Production

*REFER ALSO TO CITATION(S) 36258, 36986, 38044*

36368 **(AEEW-M—2352) Model surfactant studies 1: preliminary investigations of phase behaviour.** Lee-Tuffnell, C.D. (UKAEA Atomic Energy Establishment, Winfrith). Sep 1985. 26p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ .

Phase behaviour investigations of a model system containing surfactant, decane, brine and alcohol have begun. Salinity scans have been used to assess whether the multi-component system will produce low interfacial tensions with rapid phase equilibration and without formation of viscous gels or precipitates, within a salinity range of (1-4) wt % sodium chloride. Future experiments will investigate alcohol partitioning in order to corroborate the apparent correlation observed between alcohol concentration and optimal salinity.

36369 **(AEEW-R—2114) Gamma tomography as an aid to experimental enhanced oil recovery.** Puckett, D.A.; Sims, R.J. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. 56p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Gamma tomography has been used to image oil and brine fluids contained in the pores of sandstone. Despite the fact that the linear attenuation coefficients of oil and brine showed a difference of 37%, this difference narrowed to only 2% for oil saturated and brine saturated sandstone. However, using a brine dopant such as potassium iodide in the brine the brine/oil attenuation difference could be increased to 40% yielding excellent contrast between the two fluids. It is concluded that the gamma tomography technique can be developed to provide an inexpensive, quantitative analyser well suited to enhanced oil recovery studies.

36370 **(AEEW-R—2171) New extended black oil model for simulating gas cycling in retrograde condensate reservoirs.** Mott, R.E.; Smith, E.H. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1987. 26p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A new method of extending a black oil simulator to model gas cycling in condensate reservoirs is described. In the new model, a fourth transport equation is added to a black oil simulator to describe the behaviour of a compositional parameter, which acts as a measure of the changes in fluid properties caused by the mass transfer effects during gas recycling. Petroleum fluid properties in the simulator are functions of both pressure and the compositional parameter. The new model predictions of cumulative liquid recovery agree with those of a compositional simulator to within 2%. The extended black oil model is also able to provide compositional data such as individual component recoveries or phase compositions in a grid block, and results are presented to show the validity of this approach.

36371 **(CMI-R—852310-3) Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs.** Nystad, A.N. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). May 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752489.

It is of major importance to ascertain as early as possible whether a reservoir is rate-sensitive or not. This information influences the optimal choice of production capacity. The reservoir-technical constraints are defined by the geological and physical reservoir characteristics, the characteristics of the reservoir fluids and the reservoir drive mechanisms. The economic environment also influences the optimal choice of production capacity to about the

same degree as the technical constraints. This economic influence may result in different policy recommendations from different oil companies depleting the same reservoir. In addition the operator company and the authorities might differ in their views of the optimal depletion policy for a specific oil or gas reservoir. 11 figures, 5 tables, 14 references.

36372 (CONF-8510450—Exc., pp 1-14) **Investigation of the structure of filter cakes from bore flushing.** Hartmann, A.; Oezerler, M.; Marx, C. 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752460.

From Scientific colloquium of Sonderforschungsbereich 134 (petroleum technology - petroleum chemistry; Clausthal-Zellerfeld, F.R. Germany (24 Oct 1985).

After a description of the tasks and functions of the filter cake in bores, the requirements for filter cakes are explained. The aim of the investigation is finding a correlation between the filter cake structures and the prehistory of flushing. The technique of preparing the samples and previous results from investigations with electron microscopes are introduced and discussed.

36373 (CONF-8510450—Exc., pp 1-10) **Investigation of temperature stability of bore flushing liquids based on water.** Poege, S.; Marx, C. 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752460.

From Scientific colloquium of Sonderforschungsbereich 134 (petroleum technology - petroleum chemistry; Clausthal-Zellerfeld, F.R. Germany (24 Oct 1985).

Bore flushing liquids are subject to thermal loads, which can occur statically and cyclically. In order to examine the effect of the temperature change load on stability, an HPHT viscometer is used in realistic bore conditions. Rheology and filtration behaviour are used as parameters for judging stability. The results of the experiments with clay polymer flushing are introduced and discussed.

36374 (CONF-8510450—Exc., pp 1-27) **Investigation of rock drilling processes with diamond cutters of peg shape.** Young, F.; Marx, C. 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752460.

From Scientific colloquium of Sonderforschungsbereich 134 (petroleum technology - petroleum chemistry; Clausthal-Zellerfeld, F.R. Germany (24 Oct 1985).

The important characteristics of a new process for examining rock drilling processes and determining technical drilling parameters are introduced. The drilling test rig designed for this purpose is described, where the areas of the feed device and the rock holding are to the fore. The different drill bits with natural and synthetic diamonds are described and examined. Using selected examples, the drilling parameters of the drill bits are discussed as a function of pressure and cutting speed.

36375 (CONF-8510450—Exc.) **Investigation of the structure of filter cakes from bore flushing. Investigation of temperature stability of bore flushing liquids based on water. Investigation of rock drilling processes with diamond cutters of peg shape.** Hartmann, A.; Oezerler, M.; Marx, C.; Poege, S.; Young, F. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). 1985. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752460.

From Scientific colloquium of Sonderforschungsbereich 134 (petroleum technology - petroleum chemistry; Clausthal-Zellerfeld, F.R. Germany (24 Oct 1985).

The report presents 3 lectures held on the occasion of a scientific colloquium in Clausthal-Zellerfeld, October 24-25, 1985. The lectures have been analysed separately for the database.

36376 (DOE/BC—86/6/SP) **Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects.** Ray, R.M.; Munoz, J.D. (USDOE Bartlesville Project Office, OK; INTEVEP, Filial de Petroleos de Venezuela, SA, Caracas). Dec 1986. 596p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE87001219.

The Steam Flood Predictive Model (SFPM) was developed for the Department of Energy (DOE) by Intercomp Resource Development and Engineering, Incorporated, which is now part of Scientific Software-Intercomp (SSI) Denver, Colorado. The model was developed to estimate economically recoverable oil from reservoirs amenable to the steam flood process while requiring publicly available data. Publicly available data is generally limited to average rock and fluid properties and is usually too limited to perform most simulation studies. For this reason, a set of extensive defaults are built into the model - both in the predictive algorithms and the economic routines. For versatility, each model allows the user to supply model required parameters specific to the reservoir being evaluated. SFPM was used in the 1982 - 1984 National Petroleum Council (NPC) study on EOR Potential. The NPC reviewed and modified the predictive, economic, and data default routines to calibrate the models with field histories and current economic standards. The DOE, in a cooperative research program with the Ministry of Energy and Mines of Venezuela (MEMV), made this predictive model available to Venezuela for documentation. Annex III of the cooperative research program required Venezuela to select and fund a contractor to document the five models used in the 1984 study. SSI was selected as the contractor to document the models. The documentation for SFPM is being published as a joint DOE/MEMV document. The code listing has been added to the end of this report to provide the user maximum use of the documentation package. The user may wish to change the data input methodology to read the extensive data required for the model from a sequential file (user defined). This change will facilitate the user evaluating sensitivity runs on specific reservoir properties and steamflooding parameters as the user, on making an input error, is required to start at the beginning of data input.

36377 (DOE/BC—87/2/SP) **Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes.** Peterson, G.; Munoz, J.D. (USDOE San Francisco Operations Office, Oakland, CA; INTEVEP, Filial de Petroleos de Venezuela, SA, Los Teques). Jul 1987. 285p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87001217.

This report contains the results of efforts under the seven tasks of the Third Amendment and Extension of Annex IV, Enhanced Oil Recovery Thermal Processes of the Venezuela/USA Agreement. The report is presented in sections (for each of the tasks) and each section contains one or more reports prepared by various individuals or groups describing the results of effort under each of the tasks. A statement of each task, taken from the agreement, is presented on the first page of each section. The tasks are numbered 25 through 31. The first, second, and third reports on Annex IV, [(Venezuela-MEM/USA-DOE Fossil Energy Report IV-1, IV-2, and IV-3 (DOE/BETC/SP-83/15, DOE/BC-84/6/SP, and DOE/BC-86/2/SP)] contain the results from the first 24 tasks. Those reports are dated April 1983, August 1984, and March 1986. Selected papers have been processed for inclusion in the Energy Data Base.

36378 (DOE/BC/10841—5) **Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986.** Schechter, R.S. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). Jul 1987. Contract AC19-85BC10841. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001250.

The objectives of this research program are (1) to characterize mineral oxide surfaces and to relate these parameters to surfactant adsorption, (2) to study chromatographic effects resulting from use of surfactant blends, (3) to understand the properties of microemulsions as related to surfactant structure, and (4) to develop a thermodynamic theory of microemulsions which includes surfactant structure, cosolvents, and surfactant blends as well as the properties of the system oil and water. Progress reports are presented for the following tasks: (1) thermodynamic stability of microemulsions; (2) surfactant adsorption from aqueous solutions; (3) dielectric relaxation in microemulsions; and (4) diffusion in microemulsions. 28 refs., 19 figs., 1 tab.

36379 **(DOE/BC/10846—5) Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986.** Pope, G.A.; Lake, L.W.; Sepehrnoori, K. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). Jul 1987. Contract AC19-85BC10846. 302p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87001245.

This report consists of three parts. Part A describes the development of our chemical flood simulator UTCHEM during the past year, simulation studies, and physical property modelling and experiments. Part B is a report on the optimization and vectorization of UTCHEM on our Cray supercomputer to speed it up. Part C describes our use of UTCHEM to investigate the use of tracers for interwell reservoir tests. Part A of this Annual Report consists of five sections. In the first section, we give a general description of the simulator and recent changes in it along with a test case for a slightly compressible fluid. In the second section, we describe the major changes which were needed to add gel and alkaline reactions and give preliminary simulation results for these processes. In the third section, comparisons with a surfactant pilot field test are given. In the fourth section, process scaleup and design simulations are given and also our recent mesh refinement results. In the fifth section, experimental results and associated physical property modelling studies are reported. Part B gives our results on the speedup of UTCHEM on a Cray supercomputer. Depending on the size of the problem, this speedup factor was at least tenfold and resulted from a combination of a faster solver, vectorization, and code optimization. Part C describes our use of UTCHEM for field tracer studies and gives the results of a comparison with field tracer data on the same field (Big Muddy) as was simulated and compared with the surfactant pilot reported in section 3 of Part A. 120 figs., 37 tabs.

36380 **(DOE/BC/10847—5) Enhanced oil recovery through in-situ generated surfactants augmented by chemical injection: First annual report for the period October 1985-September 1986.** Wasan, D.T. (Illinois Inst. of Tech., Chicago (USA)). Jul 1987. Contract AC19-85BC10847. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001244.

In this report we present the results of our theoretical studies in high-pH flooding. The objective of our work was to develop a reasonable chemical model that would account for interactions between the alkali in the flood water and the acids in the crude oil, the enhanced mobility of oil due to the generated surfactants, and finally the interaction of alkali with the rock surface. The chemical model itself aims to predict saturation profiles, composition profiles and histories, and cumulative oil production. The conclusions listed below were drawn from the high-pH flooding models: a major finding of the theoretical study was that low interfacial tension at intermediate sodium hydroxide concentrations plays a dominant role in recovering oil; the dominance of the optimum region was found to persist only for favorable viscosity ratios; as long as viscosity ratio is favorable, factors such as injection sodium hydroxide concentration, sodium chloride concentration and velocity have little effect in recovering oil; reversible ion exchange leads to a delay in the chemical front whenever the NaCl or the inlet NaOH concentration is decreased; adsorption reduces the influence of the low interfacial tension region in recovering oil; therefore a faster chemical front using higher NaOH and NaCl values can actually be detrimental to ultimate oil recovery; and there is a small reduction in the advantages of using a favorable mobility ratio as far as ultimate oil recovery is concerned. However, this is offset by the prediction that the commencement of oil production is affected more in the case of unfavorable viscosity ratios. 17 refs., 35 figs.

36381 **(DOE/EIA—0501) The petroleum resources of China.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 22 Jun 1987. 91p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. File Number DE87012180.

Specifically, this report analyzes the amounts of crude oil that might ultimately be recoverable from China's onshore and offshore fields, including deposits that have not yet actually been pinpointed. The study aims at assessing, as accurately as possible, the potential limits for both discovered and undiscovered oil resources in China, as well as the rates at which petroleum might feasibly be drawn from them. It is hoped that such information will help US businessmen, industry analysts, and government leaders to appreciate more fully the economic, social, and political implications of public and private energy policies insofar as the potential for production and export of oil by this geographical area affects them. A special appendix presents EIA's year-by-year compilation of Chinese oil production on an area-by-area basis since 1939. Although the tables include a number of estimates, show some overlaps, and are limited by various qualifying notes, they still may comprise the most complete set of such data ever made available to the public.

36382 **(DOE/SF/11564—22) The comparative economics of thermal recovery projects.** Ramage, W.E.; Castanier, L.M.; Ramey, H.J. Jr. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jul 1987. Contract AC03-81SF11564. 188p. (SUPRI-TR—56). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001247.

In 1980, Williams, et al., developed a model for the economic evaluation of steam floods and in-situ combustion recovery projects. This study augments that work. The purpose of this study is twofold. First, an attempt to predict the oil recoveries for the two thermal recovery methods was made. The Marx and Langenheim model was used to determine the ultimate oil recovery in a steam-injection project, while the Gates and Ramey oil recovered volume burned model was used to determine the oil recovery in an in-situ combustion project. Second, an economic analysis using the Monte-Carlo simulation technique was done for both methods. A discounted net present value was obtained from the oil recovery schedules to facilitate comparison between the two thermal methods. It was found that both methods are economically competitive. 70 refs., 11 figs., 30 tabs.

36383 **(DOE/SF/11564—23) Mathematical analysis of single-well tracer test.** Falade, G.K.; Antunez, E.; Brigham, W.E. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jul 1987. Contract AC03-81SF11564. 91p. (SUPRI-TR—57). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001248.

Single-well tracer test as a means of evaluating reservoir in-situ fluid saturation has attracted many interests in recent years. The hydrodynamics of single-well tracer test is based on the radial flow of a tracer which can partition in the fluid saturations within the reservoir. At the same time, the tracer is mildly reactive with the mobile phase fluid saturation. This mild, irreversible chemical reaction results in the formation of another tracer species called secondary tracer. The secondary tracer is different from the parent tracer in its partition and chemical reaction characteristics. Typically, the secondary tracer is not reactive with, and has a near-zero partition coefficient with the immobile phase fluid saturation. The hydrodynamics of the above tracer system is described by a Radial-Diffusion-Convection-Reaction (R-D-C-R) type second order differential equation. The use of this equation to analyze single-well tracer test has, in the past, largely been through the application of numerical techniques. Since these techniques may suffer from inaccuracies due to adverse numerical dispersion or the problem of uniqueness arising from fitting many unknown parameters, there is a need to develop an exact analytical solution. This research work reexamines the R-D-C-R system of differential equations and obtains an exact analytical solution which heretofore has been considered impossible. Using the exact analytical solution as our basic tool, the hydrodynamic models describing all phases of the single-well tracer test were solved analytically. Graphs showing the tracer concentration profiles for each of the phases of the single-well tracer test were constructed. 37 refs., 15 figs.

36384 **(DOE/SF/11564—24) Two dimensional displacement of oil by gas and surfactant solution under foaming conditions.** Mahmood, S.M.; Brigham, W.E. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jul 1987. Contract AC03-81SF11564. 171p. (SUPRI-TR—58). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001249.

Gas displacement in the presence of surfactant under foaming conditions has been shown to enhance oil recovery. But it is a complex process because surface phenomenon is involved in it. The lack of understanding is a barrier for its commercial-scale testing

and application. A major difficulty in analyzing the production performance of such displacement is in deciding whether to treat gas and surfactant solution as a two phase mixture or as a single phase homogeneous fluid (foam). Another uncertainty is in determining the rheological behavior of gas and surfactant solution mixture flowing in the porous media. The problem is further complicated if two-dimensional flow is taking place, since the frontal geometry may also influence the performance significantly. This study was performed to investigate these problems. Flow was visually observed through a two-dimensional (x,z) sandpack of four feet length and one foot height, having 14 darcies permeability and 35% porosity. Since analytical treatment of the flow and oil recovery data has not been possible, the objectives were to get a basic understanding of the flow behavior under foaming conditions, devise conceptual models with the help of flow processes seen, and then analyze the data quantitatively using semi-analytical approaches. A model meeting these objectives was developed and successfully matched with experimental data obtained in the two-dimensional sandpack. 125 refs., 36 figs., 21 tabs.

36385 **(DTH-IMSOR-RR—1986-4) Solving two problems of oil and gas exploitation by the generalized maximum principle.** Nielsen, C.S.; Ravn, H. (Technical Univ. of Denmark, Lyngby. Inst. of Mathematical and Operations Research). 15 May 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752476.

This paper presents theoretical and computational results of a new numerical method for solving discrete-time optimal control problems with applicability to two cases, gas production using a tank model and oil production using multicycle steam stimulation. The method is based on a generalization of the maximum principle, and it thus has the distinct advantage over earlier versions of the discrete time maximum principle that it also applies in the nonconvex case. The method also allows constraints on the state vector. This makes it attractive for application to many technical problems.

36386 **(NP—7770125) Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery.** Wehrhahn, A.-K. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 3 Jul 1986. 123p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770125.

Flooding with aqueous polymer solutions is a well-established technique of enhanced petroleum recovery. Suitable polymers must have high viscosity for longer periods of time under deposit conditions. Viscosity losses are mostly the result of polymer degradation. In the investigation, degradation under deposit conditions was simulated by tempering at different temperatures and by irradiation. The three biopolymers xanthane, scleroglucane, and hydroxyethyl cellulose all three are discussed for future applications in polymer flooding.

36387 **(RF-T—41/84) Oil well drilling, labour practice, safety and environment - low mechanization level.** Netland, K. (Rogalandsforskning, Stavanger (Norway)). 12 Nov 1984. 152p. (In Norwegian). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752486.

The different phases of the construction of an oil well are studied and evaluated. Conditions important to the physical working environment is emphasized. Pipeline handling on rigs without mechanical equipment for drill pipe handling is described. Differences between anchored and floating platforms are pointed out. Technical, internal division of labour within the drill team in relationship to operating company and specialist firm is described. 6 tables, 4 drawings, 18 photos, 21 references.

36388 **Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs.** Richardson, TX; Society of Petroleum Engineers (1987). 525p. (CONF-870529—). Society of Petroleum Engineers, P.O. Box 833836, Richardson, TX 75083.

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

This book presents the papers given at a symposium on the hydraulic fracturing of oil and natural gas wells. Topics considered at the symposium included fracture mechanics, directional drilling, unsteady flow, porosity, in-situ stresses in reservoir rocks, permeability, crack propagation, coalbed methane recovery, fracturing fluids, rheology, pressure drop, reservoir temperature, hydraulic conductivity, and naturally fractured reservoirs.

36389 **Realistic fracture conductivities of proppants as a function of reservoir temperature.** Mc Daniel, B.W. (Halliburton Services). pp 515-524 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16453.

The steady-state conductivity of a propped fracture is significantly lower than has been reported in most of the data presently being used in fracture design calculations. When laboratory testing incorporates realistic parameters for temperature, and the tests are held for extended time periods, measured conductivity may only be a fraction of the previously reported value. Several authors have addressed this concern, each citing a very limited quantity of data. In some cases, only a few proppants were tested, while other authors addressed only one or two specific temperatures. This work is based on the results of more than one hundred tests where each stress level was held for extended times to create a complete family of data for a representative number of proppants.

36390 **Dynamic etching tests aid fracture acidizing treatment design.** Anderson, M.S.; Fredrickson, S.E. (Halliburton Services). pp 503-514 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16452.

Satisfactory stimulation of oil and gas bearing formations by "fracture acidizing" is dependent upon development of adequate fracture conductivity in naturally occurring or hydraulically induced fractures. The created fracture conductivity is a result of the action of acid on the exposed fracture face. Some of the kinetic parameters which will influence the resultant conductivity are acid type and strength, reaction temperature, reaction time, and flow regime. These parameters are treatment design variables which can be used to optimize fracture acidizing treatments. Formation characteristics will be equally important, and in many cases, more critical than the kinetic parameters. Some of the formation parameters which will affect the development of fracture conductivity are the mineralogical composition, degree of homogeneity, hardness, and closure stress.

36391 **Coupling of production forecasting, fracture geometry requirements and treatment scheduling in the optimum hydraulic fracture design.** Meng, H.Z.; Brown, K.E. (Dowell Schlumberger). pp 485-502 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE 16435.

There are a number of considerations to be made in the process of designing a fracturing stimulation treatment. The reservoir deliverability, well producing systems, fracture mechanics, fracturing fluid characteristics, proppant transport mechanism, operational constraints and economics should be considered and integrated in order to obtain the most cost-effective design and to maximize the benefit of a well stimulation treatment. The main purpose of this work is to develop an analytical scheme which mathematically couples each element. The criteria used to determine the optimum size of the treatment are: optimize reservoir deliverability, maximize propped fracture penetration, optimize pumping parameters, minimize treatment cost, and maximize economic returns of the well.

36392 **Mechanisms controlling fracture height growth in layered media.** Naceur, K.B.; Touboul, E. (Dowell Schlumberger). pp 467-484 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE 16433.

In a fracturing treatment, vertical and lateral growth are influenced by in-situ conditions, and by the rheological properties of the fracturing fluid. The analysis of the parameters affecting the height growth for those hydraulically induced fractures is a critical issue for predicting stimulation effectiveness. Eventually, a precise control of the height growth, and preventing the fracture from penetrating into the barriers would avoid possible water or gas coning following the treatment. The effects of the properties of the barriers, including variations in crack opening moduli, stresses, and additional stresses due to leak-off, on the rate of height growth are described. A boundary integral technique is used to evaluate the effects of treatments which impede the vertical height growth, and treatment simulations are performed with a three-dimensional fracture model.

36393 **Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment.** Bouteca, M.J. (Institut Francais du Petrole). pp 453-466 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16432.

The numerical model described in this paper has been designed to provide a realistic 3D solution for fracture propagation in minimal computation time. The procedure used to solve the equations ensures a numerically stable model since there is no iteration between the mechanical equilibrium and pressure drop equations. Comparisons with available results are given. They show good concordance for a wide range of data. A parametric study is also given and the results are compared with the Nolte analysis of the propagation pressure.

36394 **The influence of fracture toughness on the geometry of hydraulic fractures.** Thiercelin, M.; Jeffrey, R.G.; Naceur, K.B. (Dowell Schlumberger). pp 441-452 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE 16431.

This paper contains an assessment of the importance of fracture toughness in hydraulic fracturing. The results given in this paper show that fracture toughness can significantly affect both the height growth and the propagation of hydraulic fractures. Most researchers have considered the effect of fracture toughness on the geometry of the fracture to be negligible except in the cases of small fractures, during injection of very low viscosity fluids, or during fracture closure. In addition, energy considerations for two-dimensional fractures indicated that the energy losses associated with fluid flow were one to two orders of magnitude higher than the energy used in creating new fracture surfaces.

36395 **An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs.** Evans, R.D.; Ubani, E.A. (Univ. of Oklahoma). pp 429-440 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16430.

A mathematical model is presented which forms the basis of a multiphase, three dimensional reservoir simulator for characterizing multiphase flow in naturally fractured, lenticular formations. The model is general in that it can treat the presence or absence of natural fractures and/or sand lenses in a statistical fashion based upon a known distribution for each. A double porosity medium is approximated by an equivalent single porosity medium for each cell block. Similarly an equivalent permeability for each cell block is approximated by calculating an effective principal permeability as a function of rock matrix and fracture permeabilities.

36396 **On the stimulation of a northern North Sea tight sand.** Despax, D.; Charlez, P.; Clinkemaillie, J.; Economides, M.J. pp 399-408 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16428.

Thick reservoirs (about 100 m, 330 ft) have been discovered in the northern part of the North Sea, with effective permeabilities less than 0.1 md. In spite of this poor transmissivity, it has been planned to study the development of these blocks, lying under 160 m (525 ft) of sea water. Reservoir engineering evaluations have already suggested that profitability could be reached, but only if the wells are significantly stimulated. This is why an extensive fracturing feasibility study, focused on the Brent formation, was carried out. The Brent formation appears to be a sandstone which would easily be stimulated using normal hydraulic fracturing techniques and this study has revealed that sufficiently conductive propped fractures with fracture half-lengths at least equal to 150 m (500 ft) are feasible and have a reasonable chance of success, and that this size of treatment will satisfy the production increase requirements.

36397 **Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas.** Tyler, N. (Bureau of Economic Geology). pp 357-362 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16424.

The upper Cretaceous Olmos Formation has produced 157 million barrels of oil equivalent from deltaic and shore-zone sandstones in South Texas. Much of the production (2.8 million barrels of oil and condensate and 200 billion cubic feet of gas) is from low-permeability delta-front, shoreface, and shelf sandstones that compose two immature exploration plays. Recent improvements in well stimulation technologies have resulted in production increases 2.5 times to an order of magnitude greater than prestimulation yields.

36398 **Mechanical interactions in branched or subparallel hydraulic fractures.** Jeffrey, R.G.; Vandamme, L.; Roegiers, J.C. (Dowell Schlumberger). pp 333-342 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE 16422.

A numerical simulator has been used in the study of hydraulic fracture with two nearly parallel branches. The pressure required to propagate a branched fracture is found to be significantly higher than the pressure needed to extend a single planar fracture. Interactions with natural fractures have also been studied. The results show that hydraulic fractures may develop offsets at crosscutting natural fractures. Slip occurring on weakness planes after the hydraulic fracture crosses them has been modeled, demonstrating a reduction in fracture width at the site of the offset. This reduction in width may lead to proppant bridging at that location.

36399 **Modified fracture pressure decline analysis including pressure-dependent leakoff.** Castillo, J.L. (Dowell Schlumberger). pp 273-282 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE 16417.

Nolte developed an analysis of the pressure decline following a fracturing treatment to provide an estimate of fluid efficiency, fluid loss coefficient, and fracture geometry. This analysis has become an industry standard for evaluating and improving the design of fracturing treatments. The derivations by Nolte assume the leakoff coefficient is a pressure-independent constant. This assumption is valid when leakoff is controlled by a compressible filter cake. In cases where leakoff is primarily controlled by filtrate viscosity, by an incompressible filter cake, or by reservoir permeability and compressibility, the leakoff coefficient is pressure dependent, and, therefore, declines during the closure period. Under these circumstances, direct application of the Nolte technique may not be appropriate, and could cause an optimistic estimate of fluid efficiency and leakoff coefficient. This paper introduces a new plot for fracture pressure decline analysis that determines the pressure parameters required in the Nolte leakoff calculations.

36400 **Long-term performance of proppants under simulated reservoir conditions.** Much, M.G.; Penny, G.S. (Norton-Alcoa Proppants). pp 257-266 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16415.

The insitu performance of two classes of commonly used fracture proppants has been evaluated in the laboratory. Identification of the effects of time and stress on fracture proppants was determined and further, the effects of embedment and gel damage under downhole conditions was evaluated. Accurate fracture proppant parameters are now available.

36401 **Polymer emulsion: The revival of a fracturing fluid.** Roodhart, L.P.; Davies, D.R. (Shell Canada Research). pp 235-246 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16413.

Polymer emulsion hydraulic fracturing fluids were widely employed some 10 to 15 years ago, but became less popular after the introductiOn of cross-linked, water-based gel systems. The latter were thought to have a higher viscosity and be easier to handle, as well as being cheaper. However, during the last few years, polymer emulsions have enjoyed an increasing popularity in Europe because of their properties. In addition, their cost per unit volume of proppant placed is now comparable to that of water-based fluids. Addition of a Well-dispersed internal phase will increase the viscosity of any fluid over that of the external phase alone.

36402 **Low-permeability reservoirs development using horizontal wells.** Giger, F.M. (Horwell). pp 173-184 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16406.

In recent years, horizontal wells have played an increasing role as alternate production tools to vertical or slanted wells. Do they provide anything new to exploitation strategies for low permeability reservoirs? In this paper, the authors contribute to answering this question by presenting results of analytical derivations pertaining to case favorable to development with horizontal wells. The effects of anisotropy related to shaly interbedding and natural fissuring are discussed. The solutions and criteria are derived independently from the nature of the drive mechanisms because other strong influence on the production profile of horizontal wells.

36403 **Advances in borehole seismic fracture diagnostics.** Thorne, B.J.; Morris, H.E. (Sandia National Labs.). pp 165-172 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—). Contract AC04-76DP00789.

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16405.

Recent redesign of the hardware, software, and data-reduction techniques associated with a triaxial Borehole Seismic Systm have made possible better estimates of hydraulic fracture geometry. The redesigned triaxial system now incorporates three geophones per axis and provides 30 times the downhole gain of the replaced system, resulting in improved signal-to-noise ratios. This stronger signal, together with an increased digitization rate for each of the six simultaneously digitized channels from two borehole seismic tools, has made possible the acquisition and processing of data that were previously inaccessible. The new electronics makes use of a null system and an improved calibration system which includes a synthetic event generator to produce sinusoidal signals of specified amplitude, frequency, and phase.

36404 **In-situ stresses in low-permeability, nonmarine rocks.** Warpinski, N.R.; Teufel, L.W. (Sandia National Labs.). pp 125-138 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—). Contract AC04-76DP00789.

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16402.

In situ stress measurements have been performed over a 2500-ft (760-m) interval in the nonmarine section of the Cretaceous Mesaverde in the Piceance basin in Colorado. These measurements include 27 hydraulic fracture measurements of the minimum in situ stress and 22 anelastic strain recovery (ASR) measurements. Stress data were obtained in sandstones, shales, mudstones, siltstones and coals and show the effect of lithology on the magnitudes of the stresses. Most tests in nonreservoir, clay-rich rocks had stress magnitudes near the lithostatic value, while reservoir rocks had considerably lower stress magnitudes.

36405 **Observations and recommendations in the evaluation of tests of hydraulically fractured wells.** Economides, M.J. (Dowell Schlumberger). pp 49-60 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).
SPE/DOE 16396.

The pressure transient behavior of hydraulically fractured wells has been the subject of considerable study over the past few years. Several investigators have presented solutions of the fundamental equations, identified qualitative diagnostic trends and suggested interpretation techniques. This paper presents a systematic approach to the problem along with substantial observations on the potential of unique interpretations. Pre-treatment tests are considered as necessary. Well tests in tight formations are often of very short duration, to allow the use of established methodologies. Hence, a technique to calculate the maximum reservoir permeability from a short well test is offered. In the case of post-treatment tests the data are treated using the convolution/deconvolution techniques and influence functions. The term "influence function" defines a relationship between pressure response and time at a constant unit surface flow rate.

36406 **An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well.** Prado, L.R.; Da Prat. (INTEVEP SA). pp 35-48 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16395.

An analytical model is presented which describes the pressure behaviour of a well completed in a reservoir wherein natural fractures occur over a limited area around the wellbore. The flow in the reservoir is treated as a composite reservoir flow problem, the region adjacent to the wellbore being considered as a fractured medium and the outer region as an homogeneous one. Wellbore storage and skin effects are included in the solution, and the flow in the fractured region is mathematically described by Warren and Root's double porosity theory. Dimensionless log-log plots of pressure vs time show the existence of several well-defined flow regimes, which can be used in the interpretation of pressure transient tests data to estimate the fractured region parameters as well as its radius around the well.

36407 **New methods for estimating parameters of low permeability reservoirs.** Kuchuk, F.J. (Schlumberger Doll Research). pp 19-34 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16394.

The use of simultaneously measured downhole pressure and flow rate may not completely eliminate wellbore storage or afterflow effects when there is considerable additional wellbore volume below the pressure gauge and flowmeter. This paper presents new interpretation methods with or without measured wellbore flow rate, taking the additional wellbore volume into account. A diagnostic method is also presented for the determination of the correct logarithmic convolution straight line.

36408 **Short-radius lateral drilling: A completion alternative.** Parsons, R.S.; Fincher, R.W. (Eastman Christensen). pp 7-18 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 15943.

The drilling of horizontal holes from a vertical wellbore to enhance oil and gas production has become a renewed topic in well completion technology. A concept over 50 years old, lateral drilling was originally thought of as a cure for declining or marginally productive wells. Today, because of improved materials, designs, and manufacturing techniques, lateral drilling has emerged as a promising completion technique in many types of reservoirs. This paper discusses state-of-the-art, short-radius lateral completion technology, specifically the method offered by Eastman Christensen. A Michigan case history is also discussed in which the technique was used to turn a well destined for abandonment into a commercial success.

## 0204 Processing

36409 **(IFP—33-325) Catalytic and physicochemical properties of zeolites with geometrical selectivity.** Mahtout, T. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Feb 1985. 267p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752318.

Different zeolites: mordenite, offretite, clinoptilolite, ferrierite, erionite T, chabazite and merlinoite are evaluated and compared for their geometrical selectivity due to their microporosity and their acidity. Microporosity is close to the size of usual hydrocarbon molecules and catalytic reactions occur inside the crystal lattice. High acidity is required for most of the refining processes and in petrochemistry and selectivity is evaluated by physicochemical analysis (adsorption) and C/sub 6/ and C/sub 7/ alkanes isomerization and cracking. 113 refs.

36410 **(Juel-Spez—377) Mathematical programming studies of short run oil refinery rents.** Sanchez Buelga, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; Queen Mary Coll., London (UK)). Nov 1986. 433p. NTIS (US Sales Only), PC A19/MF A01.

The purpose of this study is to find general behavioural patterns or tendencies of Oil Refinery Rents in the short term with the objective of constructing functional relationships between them and their determinants. The theory of rent is examined in general, and in particular in relation to the oil refinery. Under two main hypotheses, the existence of a competitive equilibrium market for oil, and the Unidimensionality in energy pricing or The First Principle of Energy Substitution, two Linear Programming models are used to conduct experimental work: a Single Refinery Model as a representation of refinery processes and their logistics excluding transport activities; and a more comprehensive one, the 7-area World Energy Model, whereby the world oil refinery system is represented in seven oil refinery areas with their associated refinery technologies and trading links. WIth the aid of the Single Refinery, the analytical formulation of rent, and the rent formation within the refinery as changes in the exogenous market conditions occur, are both explored. The 7-area World Energy Model is used to examine the competitive behaviour of the oil refinery system in satisfying profitably the market products' demands, and the effect that has on refinery rents.

## 0205 Products And By-products

*REFER ALSO TO CITATION(S) 36276*

36411 **(AD-A—179685/3/XAB) Field evaluation of the sidestream sensors for filter/separators and clay filters.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Feb 1987. 79p. (CRC—552). NTIS, PC A05/MF A01.

In response to a 1977 survey conducted by the ASTM D 02.J Subcommittee on Aviation Fuels to assess industry needs in fuel handling, the CRC Water/Fuel Separation Characteristics Group identified six requirements for test methods which CRC should consider: 1. surfactants in fuel; 2. surfactants in the aqueous phase; 3. filter/separator conditions; 4. filter/separator life; 5 clay filter condition; and 6 Clay filter life. The Group had received a report from one panel that examined test methods for surfactants in water. The last four test needs became the objectives of a panel, established in 1980, to examine the Exxon Filter Sidestream Sensor as CRC research techniques for these purposes. Membership of the Panel and a corresponding working group of the Institute of Panel and a corresponding working group of the Institute of Petroleum which also evaluated the Sidestream Sensor appear in Appendix A.

36412 **A T-H method for heat exchanger network synthesis.** Terrill, D.L.; Douglas, J.M. (Dept. of Chemical Engineering, Univ. of Massachusetts, Amherst, MA 01003). *Industrial and Engineering Chemistry Research;* **26**: No. 1, 175-178(Jan 1987).

The temperature-enthalpy diagrams that are useful for visualizing the pinch location in a heat exchanger network can also be used to help visualize the effects obtained with different heat exchanger network alternatives. This visualization is particularly suited for many petrochemical processes where there is not much overlapping between the streams on a temperature-enthalpy diagram.

## 0206 Health And Safety

*REFER ALSO TO CITATION(S) 36476*

36413 **(CMI-R—852330-8) Safety and optimal prevention of platform accidents.** Amundsen, E.S. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Oct 1985. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752492.

The probability of a platform accident is infuenced by the resources allocated to maintenance and accident prevention. The optimal maintenance is determined by the expected economic loss for such an accident. This loss consists of, in part, the value of lost production and, in part, the value of losses of human lives. The main conclusion is that the the optimal loss-probability increases over time, due to the shrinking value of the expected loss when the petroleum reservoir is being emptied. This conclusion holds both from the point of view of society and of a private company. With heavy income taxation and lower assessment of the value of human lives, a private company may find it optimal to have a much higher loss-probability than society. 5 figures, 2 references.

## 0207 Marketing And Economics

*REFER ALSO TO CITATION(S) 36382, 36410, 36436, 36949, 36985, 36987, 36988, 36989, 36990, 37002*

**36414 (CMI-R—852310-5) Petroleum taxes and optimal resource recovery.** Nystad, A.N. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jun 1985. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752490.

The paper is concerned with the producer's adjustment to various tax regimes. For this purpose a product function is required for the exploitation of a petroleum reservoir. This function takes account of reservoir technology relationships and defines the recoverable reserves as a function of depletion strategy. The function must be adjusted for each oil or gas reservoir by means of reservoir simulations and other technical studies. It is then possible to discuss simultaneously the incentive qualities of the taxation system and the distribution of revenue between company and state. Central to this discussion is the fact that the amount of the resource is not fixed, but will be affected by the decisions made. In this way petroleum taxes affect the optimal recoverable resources. 13 figures, 5 tables, 11 references.

**36415 (CMI-R—852310-6) Progress curves for North Sea platform projects.** Nilssen, T. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jun 1985. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752491.

A progress curve for a platform project describes the relation between the accumulated elapsed construction time and accumulated project expenditures. This curve will usually be S-shaped, which means that the project has a slow start, then an intensive mid-term, and finally slowing down again when the project is close to completion. It is argued that it is feasible to use a functional relationship as an approximation for this S-curve, and that it is possible to find estimates for the parameters in such a function. Three different mathematical functions are examined. The data used to determine the parameters are taken from 20 platform projects in the North Sea. The resulting progress curves are shown together with the observations upon which they are based.

**36416 (CONF-870137—2) Transportation energy outlook under conditions of persistently low petroleum prices.** Millar, M.; Singh, M.; Vyas, A.; Johnson, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011477.

From Transportation Research Board annual meeting; Washington, DC, USA (13 Jan 1987).

Much as the rising oil prices of the 1970s profoundly influenced petroleum production and consumption, an era of persistently low prices will have far-reaching consequences for petroleum supply and demand. Many of those consequences are indirect and will not be widely understood for some time; others are more clear-cut. This paper explores some of the anticipated consequences - including revised estimates of domestic petroleum reserves, production, consumption and imports. It focuses on transportation, the largest consumer of petroleum products and the most petroleum-dependent sector, and concludes that persistently low oil prices will result in a significant decline in domestic oil production, a modest increase in petroleum consumption overall and in the transportation sector (primarily due to a reduction in the fuel efficiency of the vehicle fleet), and a substantial increase in our import dependence and vulnerability to supply interruptions and price shocks. Together these effects increase the need for improved fuel efficiency and fuel flexibility, yet reduce the market incentive to develop and introduce new fuel saving technologies.

**36417 (DOE/EIA—0380(87/04)) Petroleum marketing monthly, April 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 1 Jul 1987. 172p. NTIS, PC A08 - GPO. File Number DE87012182.

The Petroleum Marketing Monthly gives information and statistical data about a variety of crude oils and refined petroleum products and provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

**36418 Kalman-filter estimation of monthly US oil imports.** Martz, H.; Burris, A.; Bruckner, L.; Bivins, R. (Los Alamos National Lab., NM). *Energy (Oxford);* **11**: No. 3, 271-280(1986).

The Kalman filter technique was used to forecast US monthly oil imports with a two-month lead. The state equation used was an ARIMA (1, 1, 0) model, and the observation equation was a regression of the revised, estimated and company-forecasted values on the true values. Results indicate that the Kalman filter estimates are superior to the company-provided values. The total forecasts are in agreement with true values and lie within the 95% confidence bounds. The incorporation of econometrically derived observation equation is recommended. A detailed example of the Kalman filter estimate calculation is presented in the Appendix. 14 references, 5 figures, 3 tables.

## 0208 Waste Management

*REFER ALSO TO CITATION(S) 37816*

## 0209 Environmental Aspects

*REFER ALSO TO CITATION(S) 36425, 36956, 37647, 37679, 37835, 38002*

**36419 (IKU-R—05.1704.00/01/84) Dispergents influence on evaporation and dissolution of oil on seawater.** Bowler, B. (Instituut for Kontinentalsokkelundersoekelser, Trondheim (Norway)). 26 Nov 1984. 27p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752485.

The aim has been to determine how the small hydrocarbons (C/sub 1/-C/sub 10/) from oil floating on the water surface distributes in the air and water phases and how addition of dispergents influence conditions. The MacKay method is used. Samples from air and water at different times after addition of oil/oil and dispergents are taken and analysed. All tests have simulated natural conditions. Experiments have been carried out with Statfjord and Ekofisk crude oil and various water and air samples. 23 tables.

**36420 (NIVA-O—82007) Long term effects of oil on marine benthic communities in enclosures.** Bakke, T. (Norsk Inst. for Vannforskning, Oslo). 7 Jan 1985. 250p. NTIS (US Sales Only), PC A11. File Number DE87752501.

The report presents results obtained during 1982-1984 in the subproject under the main research programme. It deals with research fields such as hydrocarbon content in water and organisms (4 species), littoral community structure, effects of diesel on algae, particularly the growth, oil pollution effects on sea organisms and marine habitat conditions as such. The water analysis are performed mainly by fluorescence analysis and gas chromatography. The community studies are made in 4 basins and give a brief survey of present species. In the oil pollution studies community structure on granite chips in 4 basins compared to a sheltered locality are made

and concern mainly coverage and growth. Population dynamics, genetics and the energy balance of and sublethal cellular and molecular effects on littorina littorea in an oil polluted environment are studied as well as the population genetics of and sublethal biological, cellular and molecular effects on mytibus edulus. Genetic and demographic variations of balanus balanoides in such environment are recorded. Studies with experimental enrichment sedimentation of the soft bottom mesocosm at the experimental station are carried out. They focus mainly on meiofauna structure and the importance of meiofauna/macrofauna interactions are emphasized. Finally a study comparing the above mesocosm and the mesocosm from other fields samples were made. Most of the results presented are preliminary. 91 references, 115 drawings, 59 tables, 3 photos.

36421 **(PFO—1410) Effectiveness of oil dispersants laboratory experiments.** Nes, H. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Oslo. Program for Oljevernberedskap). Oct 1984. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752484.

This project is a continuation of an earlier Program for oljevernberedskap-prosjekt (PFO-project) (No. 1405) and the aim has been to study the effectiveness of different dispersants applied on oil qualities and at temperatures relevant to Norwegian conditions. The effectiveness tests used are the so called MacKay-method and a revised version of the WSL-test (WSL/IVL-test). Some interfacial tension measurements are also undertaken on oil-water dispersant systems by using a spinning drop tensiometer. The experiments are undertaken at 13.6 and 1.5-3 deg C. A total number of 13 concentrated dispersants is now tested, in this and in the earlier project. The oil qualities covered are Ekofisk crude, bunker fuel IF-30. In some experiments Statfjord crude oil and weathered and emulsified Statfjord oils are used. Lowering of temperature caused different effects among the different dispersants and oils tested, and is discussed in the report. The weathering and emulsion formation both caused a significant decrease in dispersing efficiency, when the same dispersant was used. Experiments performed with the MacKay-test and the WSL/IVL-test at the same conditions gave very different results and several reasons for this are discussed. A better knowledge of droplet size distributions is considered to be of great importance to obtain a better understanding of the results produced in different laboratory tests, as well as in field experiments. 18 tables, 52 drawings, 19 references.

36422 **(RF-T—45/84) Biodegradation of oil on cuttings - I.** Bilstad, T. (Rogalandsforskning, Stavanger (Norway)). Jan 1985. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752487.

The objectives of the study were: 1) To determine natural degradation rates of oil adhering to cuttings in a marine environment. 2) To determine stimulated biodegradation rates of oil on cuttings. Analytical techniques were established. Oil was extracted and quantified from different cuttings. Methylene chloride used in a Soxhlet apparatus extracted the oil in reproducible quantities. The oil mass varied from 5-20% diesel by wet sample weight from one cutting to another. The diesel was defined within the normal paraffins C/sub 8/ to C/sub 26/ and contained approximately 25% aromatics. The mineral oil cuttings had significantly smaller particle size than the diesel cuttings and were more time consuming to extract. The mineral oil based cuttings contained approximately 23% CH by wet sample weight with 90% in the n-C/sub 13/ to n-C/sub 15/ range. The aromatic content was approximately 5%. The hydrocarbon quality was characterized by using a combination of glass capillary gas and medium pressure liquid chromatography. Final characterization was done by glass capillary gas chromatography mass spectrometry with an integrated data system. Results were checked with alternative methods. Natural and stimulated biodegradation studies of oil on cuttings were performed in the laboratory by way of continuous biochemical oxygen demand (BOD) measurements in the Sapromat and by bacteria count from flasks subjected to continuous stirring. Both procedures were coupled to GC/MS analytical techniques. Aquarium experiments with four 350 liter aquaria containing 25 kg of cutting were carried out. They received 10 deg C sea water at horizontal velocity of approximately 1x10/sup -3/ cm/s. Neither the nutrient stimulated nor the untreated cuttings experienced significant biodegradation after months in the aquaria. Some physical dissolutions were experienced in the top layers of cuttings. 21 drawings, 3 tables.

36423 **(STF—21A85102) Follow-up studies of areas which have been polluted by oil.** Denstad, J.P.; Klokk, T.; Sveum, P. (SINTEF, Trondheim (Norway)). 25 Nov 1985. 17p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752498.

Since 1983 there has been follow-ups on areas which have been exposed to oil spills: Rennesoey near Stavanger and Bratthol-men at Helgeland. The report gives a survey of and the status of the vegetation, macroinvertebrates and nemathods. On a shore near Agdenes (by the end of the Trondheims fiord) there are 3 fields that have been exposed to experimental oil spills, which have been studied with regrowth in mind. 3 tables, 9 drawings.

## 0220 Transport, Pipelines, And Handling

36424 **(PB—87-185302/XAB) Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983.** Voelker, R.P.; Geisel, F.A.; Dane, K.E. (Arctec, Inc., Columbia, MD (USA)). Nov 1983. 593p. (REPT—800C-VOL-3). NTIS, PC A25/MF A01.

See also Volume 2, PB—87-185294, Volume 4, PB—87-185310, and report dated Nov 82, PB—84-129642; Also available in set of 4 reports PC E99, PB—87-185278.

Environmental and ship-performance data were collected aboard the USCGC POLAR SEA during the period March-May 1983 as part of a multi-year program to make an operational assessment on the feasibility of a year-round marine transportation system (including offshore structures) serving Alaska. This is the third volume of a four-volume set and focuses on the performance of the icebreaker from the ice edge in the South Bering Sea to the North Chukchi Sea at Wainwright, Alaska.

36425 **(PB—87-185849/XAB) Methods of prevention, detection, and control of spillages in west European oil pipelines.** Bown, J.R.; Bianchini, M.; Lighthart, M.; du Payrat, C.N.; Whitemore, J.B. (Concawe, The Hague (Netherlands)). 1987. 35p. (CONCAWE—1/87). NTIS, PC PC E03/MF E01.

The report reviews the causes of spillage from operating cross-country oil pipelines and discusses the current practice in spillage prevention, detection, and control. Performance data for the past fifteen years shows that the rate of spillage has continued to be extremely low. Spillages are prevented by competent design, careful construction, rigorous inspection and efficient operation. Monitoring of the pipeline provides the information necessary to satisfactorily maintain the system and to allow a reaction to deviations from the norm. The oil industry applied considerable effort to provide a safe and efficient pipeline-transport service, whose performance record ranks amongst the best. Efforts will continue to be exerted to maintain and further improve on the high standards already obtained.

36426 **Consistent flow regime map and friction factors for two-phase flow.** Solbrig, C.W. New York, NY; American Institute of Chemical Engineers (1986). 41p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

77F.

Many of the existing constitutive models found in large computer codes for two-phase transient flow contain errors and discontinuities. This paper presents a model which can eliminate these difficulties for steam-water flow in vertical pipes. The same model defines the flow regime and the geometry used for the evaluation of both the interphase and wall friction factors. A continuity of models traverses the void fraction domain from small bubbles recombining to larger bubbles, large bubbles elongating into slugs, and long slugs becoming infinite to produce annular flow. The bubble slug transition occurs at a void fraction of Pi/6 and the slug annular transition occurs at Pi/4. Cocurrent and countercurrent flow can be represented with a new flow regime map because the phasic velocity difference and void fraction are used as coordinates. The Moody model is used to obtain all friction factors and sub-

structure sizes determine the roughness. Representative results are obtained from this model to show the reasonableness of the calculated friction forces for a range of flow regimes and phase velocities.

### 0230 Properties

*REFER ALSO TO CITATION(S) 36422*

### 0240 Storage

36427 **(DOE/FE—0084-1) Strategic Petroleum Reserve: Quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 15 May 1987. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011945.

This quarterly report describes activities undertaken with respect to the development of the Strategic Petroleum Reserve during the period January 1, 1987 through March 31, 1987. The introduction and summary briefly discuss program background and major activities of this quarter. Section II describes site development. Oil acquisition activities are reported in Section III. Information on the budget and cost of the Reserve is contained in Section IV. During the first quarter of 1987, Strategic Petroleum Reserve storage capacity reached approximately 563 million barrels. At Bryan Mound, the conversion of Cavern 5 from sweet to sour crude oil storage proceeded on schedule, and at West Hackberry, leaching continued on four of the five remaining incomplete caverns. A capacity gain of 10 million barrels was realized at Bayou Choctaw with the completion of testing of Cavern 17. The total inventory of crude oil stored in the Strategic Petroleum Reserve reached 519,986,787 barrels during the quarter ending March 31, 1987. The average fill rate during the quarter was 93,575 barrels per day, and the weighted average delivered price during this quarter was $17.80 per barrel. Funds available for obligation in fiscal year 1987 include $526 million in the SPR Petroleum Account for the acquisition and transportation of crude oil and $262 million in the Strategic Petroleum Reserve Account for activities associated with storage facilities development and the operation and management of the Strategic Petroleum Reserve. 2 tabs.

36428 **(SAND—87-0706) Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses.** Biringer, K.L. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012514.

This report describes analyses of high-resolution pressure data collected on Caverns 2 and 110 at the Bryan Mound, Texas, Strategic Petroleum Reserve (SPR) site. A model of cavern pressurization is developed and applied to the two caverns. Use of the model to detect cavern pressure anomalies is demonstrated. Recommendatons are provided for improvements in pressure monitoring and cavern operation to enhance the usefulness of pressure mesuring as a tool in long-term cavern integrity monitoring. 5 refs., 16 figs., 2 tabs.

### 0250 Combustion

*REFER ALSO TO CITATION(S) 36335*

36429 **(EPRI-AP—5247) 1986 fuel oil utilization workshop: Proceedings.** Sanders, C.F.; McDonald, B.L. (Energy Systems Associates, Tustin, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 428p. (CONF-8610288—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920473.

From 2. fuel oil utilization workshop; Philadelphia, PA, USA (7 Oct 1986).

A workshop to consider problems related to fuel oil utilization was held in Philadelphia, Pennsylvania, on October 7-9, 1986. The 77 participants included fuels, engineering, and operating representatives of 21 US utilities, one Canadian utility, the Instituto de Investigaciones Electricas (Mexico), the Central Electricity Generating Board (Great Britain), the Electric Power Research Institute, and contractors engaged in EPRI fuel oil projects. The primary objective of the meeting was the interchange of information related to fuel oil projects conducted by some of the utilities, EPRI, EPRI contractors, and others. Through the discussions, EPRI gained useful insight into directions for continuing and future studies and utility support efforts. The presentations and discussions addressed fuels and combustion related problems encountered in utility boiler systems burning residual fuel oils as the primary fuel. Included were the results of fundamental studies, plant tests and demonstrations, and operating experiences. Among the major topics covered were the fundamentals of particulate formation, technology for reducing particulate emissions, utility experiences with burning emulsions (both oil-in-water and water-in-oil), stability and compatibility of residual oils, fuel quality control, fuel oil research and experiences in Great Britain and Mexico, and the progress and results from EPRI sponsored efforts related to fuel oil utilization. All papers in this proceedings have been processed for inclusion in the Energy Data Base.

## 03 NATURAL GAS

### 0301 Reserves

*REFER ALSO TO CITATION(S) 36437*

### 0302 Geology And Exploration

36430 **(DOE/MC/21131—2350) Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985.** Jeffrey, A.W.A. (Global Geochemistry Corp., Canoga Park, CA (USA)). Feb 1987. Contract AC21-84MC21131. 180p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87006489.

Phase I of this project was designed to collect and analyze hydrocarbon gases from three major sources: deep sedimentary basins, abiogenic, and subducted sediments. Results of the analytical scheme have been used to differentiate subduction zone gases from gases of deep sedimentary or mantle origins. One of the major diagnostic tests is the ratio $^{3}He/^{4}He$, an unequivocal indicator of mantle contribution. Gases were collected and analyzed from the Permian Basin, West Texas, a major deep sedimentary basin, and Iceland, where mantle gases are released into the crust at a spreading ridge. Subduction zone gases were collected in two groups: geothermal gases from volcanic arcs in the Philippines, New Zealand and Alaska, and hydrocarbon production gases from forearc and backarc locations in Taiwan, New Zealand, Alaska, Barbados, Indonesia and the Philippines. Phase II of this project is designed to collect and analyze gases from the western margin of North America, an area of past and present subduction activity, and by applying the differentiation criteria established in Phase I, determine the origin of the gases. 138 refs., 41 figs., 4 tabs.

36431 **Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming.** Charpentier, R.R.; Law, B.E.; Prensky, S.E. (USGS). pp 153-164 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16404.

The Pinedale anticline, located in the northern part of the Green River basin of Wyoming, contains a large accumulation of overpressured natural gas within a low-permeability sequence of Upper Cretaceous rocks. The geologic factors which control the gas accumulation can be used to create a quantitative model of the accumulation. Such a model was constructed for the Pinedale anticline and used for a resource estimation. Within this 197 mi/sup 2/ [317 km/sup 2/] structure, the 10,000 ft [3048 m] section of overpressured rock is estimated to contain 159 tcf [4.50x10/sup 12/ m/sup 3/] of in-place natural gas in the sandstone reservoir, although only a small part of this resource may be recoverable.

**36432 Reliability of laboratory measurement of porosity in tight gas sands.** Luffel, D.L.; Howard, W.E. (ResTech Houston Inc.). pp 115-124 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16401.

Accurate routine core porosity measurements are critically important in tight gas sands. Because of a growing concern that current routine core analysis may not be reliable at low porosity a study was conducted to verify and improve, as needed, the routine service laboratory procedures normally used. Routing analysis of ambient porosity was performed by a service company laboratory on 242 core plugs from the Travis Peak formations of a well in Panola County, Texas. Twenty of the plugs were then analyzed by two additional service company laboratories for porosity. Each of the three laboratories had problems with their porosity results, which would normally have gone unnoticed. After reruns, agreement among the labs was excellent, with an average standard deviation of about 0.25 porosity units when comparing one lab against another.

**36433 The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks.** Norman, R.; Archer, J.S. (Imperial College). pp 103-114 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16400.

The present work was carried out to investigate the effect of pore structure on non-Darcy gas flow to enable a better understanding of the relationship between the inertial coefficient and various rock properties. Measurements of porosity, permeability, inertial coefficient and capillary pressure were made on some 40 core samples, as well as visual observations under optical and scanning microscopes. The results obtained using this integrated approach helped to explain the wide scatter observed in conventional inertial coefficient - permeability correlation plots. It is shown that the inertial effect is not only a function of porosity and permeability, but is also controlled by other factors.

## 0303 Drilling, Production, And Processing

*REFER ALSO TO CITATION(S) 36371, 36385, 36389, 36400, 36408, 36986, 38044*

**36434 Recovery efficiency aspects of horizontal well drilling in Devonian shale.** Salamy, S.P.; Saradiji, B.S.; Okaye, C.O.; Mercer, J.C.; Yost, A.B. II. (U.S. DOE METC). pp 217-226 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16411.

This study is part of the Department of Energy's Eastern Gas Shales research whose primary objective is to increase the gas reserves for the Devonian shales in the Appalachian, Illinois, and Michigan Basins. The study simulated the effect of using horizontal wells to increase the recovery efficiency of shale gas from two specific sites: Wayne County, West Virginia, where vertical well gas production has been historically high and no permeability anisotropy is thought to exist, and Meigs County, Ohio, an area with a history of moderate gas production and a calculated permeability anisotropy of approximately 8:1. In this study, a three-dimensional, dual-porosity reservoir simulator was used to characterize the study areas after sensitivity analyses were made to determine those parameters significant in determining gas production profiles.

## 0306 Marketing And Economics

*REFER ALSO TO CITATION(S) 36414, 36949, 36987, 36988, 36989, 36990, 37002*

**36435 (CMI-R—852243-2) Economic analysis of natural gas contracts.** Smeers, Y.; Boucher, J.; Hefting, T. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Dec 1985. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752488.

The report proposes a methodology for evaluating the economic advantages of natural gas contracts, and illustrates it with some particular questions related to the flexibility of Norwegian gas supplies. The work has been conceived as a feasibility study: it tries to emphasize the concepts rather than to provide accurate numerical results. Beside its methodological aspects, the work certainly provides evidence about the economic importance of flexibility. Flexibility may be expensive, because it involves space capacities. It is important in that context to gain an understanding of the market that would help provide alternative solutions to the simple development of excess capacities. Very preliminary investigations with the model point to the particular role played by United Kingdom in the European gas market, and to the benefits that would accrue to Norway from a more fluid structure of the market. 12 tables.

**36436 (CMI-R—862333-3) Optimal investments using empirical dynamic programming with application to natural resources.** Stensland, G.; Tjoestheim, D.B. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Dec 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752493.

A number of practical problems arise when dynamic programming is applied to investment problems ranging over several periods. Attempts have been made to circumvent these problems by using continuous-time models, where the state process is generated by a stochastic differential equation. In this paper it is assumed that the state process is described by a discrete Markov time series model that can be fitted to empirical data. Once the model fitting is concluded, empirically determined transition probabilities can be generated using analytical arguments or simulations. Standard computer algorithms can then be used to obtain optimal policies. A substantial part of the paper consists in application of the methods to two examples in natural resources: a copper mine investment problem and a decision problem involving a natural gas field. It is shown that the optimal policies depend critically on the specification of the state process. 12 tables, 24 references.

**36437 (EPRI-P—5284) Projections of cost of development of US natural gas potential: Final report.** Kent, H.C.; Gangwar, A.; Guzman, J. (Colorado School of Mines, Golden (USA). Inst. for Energy Resource Studies; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 471p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920494.

Numerous planning decisions within the sectors of the economy which are producers, transporters and users, or potential users, of natural gas as well as in the political realm must be based upon a sound knowledge of the relative problems and costs involved in resource development. This project has attempted to gather the data and analyze the results relating to natural gas resources of the United States in a rational manner which can provide a logical basis for many of the planning decisions which must be made. The project began with the work of the Potential Gas Committee. This project has had three objectives: (1) to assemble a data base of information regarding the distribution of the postulated natural gas resource of the United States based on Potential Gas Committee work, but with added data necessary for evaluation of development costs, (2) to develop a methodology for evaluating the relative costs of development of the natural gas resource potential estimated by the Potential Gas Committee and to calculate the relative costs of development of the natural gas resource potential for those geographic areas for which estimates have been made by the Potential Gas Committee and for which meaningful data on drilling costs and other factors are available, and (3) to present these data in such a way that meaningful comparisons can be made between alternate

sources. The data base of basic resource data, together with the calculated cost of development of the natural gas resource for each of the studied provinces, is included in Appendix I. Drilling cost data are included in Appendix II. These data tables form an important part of the results of this study. These data have been derived from both the judgment of the members of the Potential Gas Committee and the interpretations of the staff of the Institute for Energy Resource Studies. 10 refs., 13 figs., 5 tabs.

## 0308 Environmental Aspects

*REFER ALSO TO CITATION(S) 36459, 37835*

**36438 (UCID—19348-Rev.1) FDAS hardware and firmware description, liquefied gaseous fuels (LGF) data acquisition system: 1987 update.** Martins, S.; Goldwire, H.C. Jr.; Johnson, G.W. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012312.

The FDAS are the front-end data acquisition units of the Liquefied Gaseous Fuels Data Acquisition System (LGFDAS). Starting with the liquefied natural gas (LNG) dispersion and vapor burn experiments conducted at the Naval Weapons Center, China Lake, California, in 1980 and 1981, they have been employed on all LLNL dispersion tests to acquire data from numerous sensors. The FDAS units work with an LSI-11 based polling and data storage system at the control room. This is a description of the hardware, functions, commands, messages, data buffer formats, and firmware of the FDAS units. This report is an update of UCID-19348 written by John Baker and reflects the latest hardware and software upgrades performed during 1984 to 1986 at LLNL by the current authors. The current version of the FDAS firmware was successfully employed in 1986 for hydrogen fluoride tests conducted by LLNL for Amoco. 5 figs.

## 0309 Artificial Stimulation

*REFER ALSO TO CITATION(S) 36388, 36390, 36391, 36393, 36394, 36395, 36396, 36397, 36398, 36399, 36401, 36402, 36403, 36404, 36405, 36406, 36407*

**36439 (PB—87-185203/XAB) Co-production of gas and water, fifth year. Annual report, August 1985-July 1986.** Howell, R.W.; Peterson, K.P.; Anderson, L.L.; Parisi, W.A. (Eaton Operating Co., Inc., Houston, TX (USA)). Aug 1986. 87p. NTIS, PC A05/MF A01.

See also PB—86-154556.

The objectives of this research effort were to locate, evaluate, acquire and test one or more co-production prospects. A prospect identification program was developed to locate prospective co-production reservoirs on the Texas Gulf Coast. The reservoirs identified were ranked according to their potential for enhanced gas recovery, monitored and updated from industry activity at or near the prospects. N.E. Hitchcock, one of the two highest ranked prospects, was recommended to and approved by GRI as a co-production test project. The project, currently in progress, proceeded in two distinct areas, (1) research on water treatment of brine produced in conjunction with gas, and (2) a field wide test of the Frio 9100 reservoir. The water treatment study has been completed and the co-production testing is currently in progress. The second prospect, Port Arthur, recently initiated testing of the Frio Hackberry C reservoir.

**36440 The GRI staged field experiment.** Holditch, S.A.; Robinson, B.M.; Whitehead, W.S.; Ely, J.W. (Texas A and M Univ.). pp 409-428 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16429.

The Gas Research Institute's (GRI) Tight Gas Sands Program has been involved with research on low permeability formations during the past four years. The main focus of the research has been to improve the general understanding of producing tight reservoirs, while a specific focus has been to advance the technology involving hydraulic fracture geometry. The unique aspect of this research is that the laboratories have been actual gas wells completed in the Travis Peak formation in East Texas. To fully extend the development of technology, GRI has planned four Staged Field Experiments (SFE) from 1986 through 1989. The SFE program provides the opportunity to collect a wealth of data that cannot be obtained from normal cooperative research wells. The purpose of this paper is to summarize all the tests and data collected on the first SFE and to present the available results from the analyses of these data.

**36441 The analysis of complex Travis Peak reservoirs in east Texas.** Holditch, S.A.; Robinson, B.M.; Whitehead, W.S. (Texas A and M Univ.). pp 381-399 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16427.

As part of a research program sponsored by the Gas Research Institute (GRI) a substantial engineering effort is being exerted towards better understanding of complex reservoir systems. The thrust of this work has been in the Travis Peak formation of east Texas which is a multi-layered reservoir that normally produces both gas and water. To properly analyze this formation, a three-dimensional and/or two-phase reservoir simulator is needed. This paper presents a thorough discussion of the problems associated with the analysis of complex reservoirs and illustrates these problems with numerous field examples. Examples are included in which short, high conductivity fractures are calculated when conventional analysis techniques are used. However, a longer more realistic estimate of fracture length is computed when one uses a multi-phase, multi-dimensional reservoir model.

**36442 An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado.** Duda, J.R.; Hancock, J.S. (U.S. DOE METC). pp 371-380 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16426.

This paper shows a relationship between the Rulison Field and an area south of Rulison, which encompasses approximately 36 square miles (93.2 km/sup 2/). The area has been sparsely drilled to date averaging one well per two sections and nonuniformly spaced); thus, the possibility exists for further commercial development through infill drilling. The southern Rulison area is characterized in structure, percent sand, and critical reservoir parameters including permeability. Production rates, cumulative gas production, and drilling and completion data are used to infer permeabilities by history matching, using a dual porosity, dual permeability reservoir simulator.

**36443 Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics.** John, P.W. (Univ. of Clausthal). pp 363-370 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16425.

Starting from Rotliegend well evaluation in parts of the European Southern Permian Basin this paper is addressed to a main problem of stimulation design in deep layered gas bearing formations. Advanced in situ analysis discloses a gap in the approach of conventional theory to in situ reality of complex multilayer systems. Uniaxial strain tests on cores prove the presence of layers with non linear elastic deformation characteristics. The impact of a hydraulic treatment on a strata-system comprising layer properties beyond LEFM behaviour is not covered by conventional assumptions. Consequently it is necessary to review basic treatment design

approaches. As a result this paper tries an analysis of sandstone-shale multilayer systems.

36444 **The influence of reservoir properties and geologic setting on coalbed fracturing and production: A preliminary evaluation of the TEAM project.** Reeves, S.R.; Wallace, J.A.; Beavers, W.M. (Taurus Exploration Inc.). pp 343-356 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16423.

The Energen Corporation initiated the TEAM coalbed methane production project in the Black Warrior Basin in 1986. Thirty wells in the Oak Grove Degasification Field were drilled, completed and stimulated in the Mary Lee/Blue Creek coal seams. An agressive technology development plan was implemented which included detailed geologic studies, reservoir characterization, fracture treatment design evaluation and early post-fracture production analysis. The results of these investigations are presented in this paper.

36445 **The use of simulation and history matching to determine critical coalbed methane reservoir properties.** Zuber, M.D.; Sawyer, W.K.; Schraufnagel, R.A.; Kuuskraa, V.A. (Lewin and Associates Inc.). pp 307-316 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16420.

Key coalbed methane reservoir properties can be determined using a logical history matching analysis procedure that incorporates laboratory, geologic and production data. Methane and water production data were history matched using a dual-porosity, two-phase finite difference reservoir simulator modified to account for the storage and flow mechanisms unique to coal. Two field examples demonstrate the results and show the applicability of reservoir modeling to assessing the effectiveness of stimulation and predicting well performance.

36446 **Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs.** Decker, A.D.; Horner, D.M. (Resource Enterprises Inc.). pp 297-306 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16419.

The ability to produce low cost, pipeline quality gas from low permeability deep coal reservoirs depends largely on thorough integration of exploration methods with appropriate drilling, completion and production strategies. In the extreme case, areas that are not economic with current completion technologies should be avoided with adherence to prudent exploration practices. Therefore, reliable predictive geologic methods to specify coal reservoir conditions need to precede drilling and completion decisions. Dominant coal reservoir mechanisms include: permeability, saturation, reservoir pressure and gas-in-place. Production characteristics from low permeability coal reservoirs are most sensitive to the interaction between type of saturation and reservoir pressure.

36447 **An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado.** Mc Fall, K.S.; Wicks, D.E.; Kelson, B.; Sedwick, K.; Brandenburg, C. (Lewin and Associates Inc.). pp 283-296 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16418.

The Piceance Basin in northwestern Colorado contains the largest concentration of coalbed methane in the U.S. A detailed geologic analysis of the basin shows that the basin contains 84 TcF of coalbed methane in-place. The east-central area of the basin contains the greatest volume of resource and is a potentially promising area for gas recovery due to its proximity to structural deformation and consequent permeability enhancement. The geologic analysis compiled extensive well data to correlate and map the subsurface extent of the Cretaceous age coals thereby determining coal volumes. Newly derived correlations of coal rank/depth with gas content were used along with coal volume to estimate in-place gas.

36448 **Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids.** Phillips, A.M.; Couchman, D.D.; Wilke, J.G. (The Western Co. of North America). pp 267-272 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16416.

High temperature rheology of carbon dioxide foam fracturing fluids has been developed in the laboratory and successfully applied to improve the design of foam fracturing treatments of tight gas sands. In the laboratory phase of the project, carbon dioxide foam properties were measured to 250°F (121°C) in a high temperature, high pressure pipe viscometer. The effects of foamer type and concentration on high temperature carbon dioxide foam rheology were determined. It was found that, above a certain level, further increases in foamer concentration provide little corresponding increase in foam stability or rheology. Carbon dioxide foam stability can be improved by the use of higher concentrations of gelling agent.

36449 **Hydraulic fracture treatment design simulation for the Rotliegendes formation.** Acharya, A.; Kim, C.M. (BJ-Titan Services). pp 247-256 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16414.

As an increasing number of gas fields are being developed or are planned to be developed in the permian red beds (Rotliegendes) of northwest Europe, hydraulic fracturing has become a major stimulation method to obtain economic production rates from this tight gas formation. Optimization of stimulation design and its implementation in the field become more crucial in the formation such as Rotliegendes, where a water bearing zone is underlain. The objective of this work was to simulate fracture growth under various conditions so that optimal treatments can be designed and implemented successfully to this tight gas reservoir. Two field applications are presented to demonstrate the proper design and successful stimulation treatments in the Rotliegendes.

36450 **Reservoir properties required for profitable stimulations.** Dietzel, H.J.; Ernst, P.L. (Preussag Erdol und Erdgas). pp 227-234 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16412.

Profitability of production from low permeability gas reservoirs is mainly determined by the increment of production obtainable by hydraulic fracturing as well as by the initial flow capacity of the untreated well. In this paper a method is presented, which allows a judgement of profitability of low permeability gas production on the basis of log-analysis and well-testing data only. Deduced from reservoir models production profiles for an untreated and a fractured well, respectively, are calculated. To these production profiles basic profitability analysis are applied, considering drilling and completion costs, surface treatment installations, and MHF-treatment charges. The limiting value of profitability is characterized by a dcf-rate of 15%.

**36451 Devonian shale horizontal well: Rationale for well-site selection and well design.** Yost, A.B. II; Overbey, W.K.; Salamy, S.P.; Okoye, C.O.; Saradiji, B.S. (U.S. DOE METC). pp 207-216 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16410.

This paper discusses the rationale for selection of a well site where geologic and reservoir conditions are favorable for a horizontal well to increase gas recovery efficiency over that of vertical wells. In this effort, an area of favorable geology was selected and a multi-site reservoir evaluation study was conducted to determine an appropriate location for a long horizontal wellbore in the Devonian shale in southwestern West Virginia. Within a candidate reservoir, existing wells and their suspected directional properties were analyzed to develop the best candidates for location of the horizontal well. Reservoir data from over 38 wells in the area were used to establish areas of high flow capacity.

**36452 Application of horizontal drainhole drilling technology for coalbed methane recovery.** Logan, T.L.; Schwoebel, J.J.; Horner, D.M. (Resource Enterprises Inc.). pp 195-206 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16409.

Methane gas contained in coal represents a potential new gas supply. Transformation of this large gas-in-place resource to reserves will depend on developments of modified and/or new completion methods to achieve long-term economic production. Coal reservoirs typically have very low matrix permeability with gas being desorbed from the matrix to the wellbore through a system of natural fractures or cleats. Due to low permeability, coal reservoirs usually require hydraulic fracture stimulation to achieve economic production. Investigations have shown that hydraulic fractures usually propagate parallel to the maximum stress or face cleat direction, and therefore may not adequately access an anisotropic reservoir.

**36453 Performance comparison of vertical and horizontal hydraulic fractures and horizontal boreholes in low permeability reservoirs: A numerical study.** Sung, W.; Ertekin, T. (Pennsylvania State Univ.). pp 185-194 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16407.

A single/two-phase, multi-dimensional, finite-difference numerical reservoir simulator, which had been validated through history matches against field data, was used to investigate and compare the production performances of horizontal wells and hydraulically stimulated vertical wells. In the case of vertical wells performance characteristics of vertically and horizontally fractured systems were studied. In the mathematical formulation of the transport problem a multi-mechanistic flow mechanism which is obtained by superposition of the Darcian and Fickian flow components is implemented to describe the flow of gas in tight porous media. The non-linear system of equations resulting from the finite difference approximation are solved by using fully implicit generalized Newton-Raphson procedure.

**36454 The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field.** Whitehead, W.S.; Hunt, E.R.; Holditch, S.A. (S.A. Holditch and Associates Inc.). pp 139-152 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16403.

This paper presents an overall summary of the in-situ stress data obtained through the Gas Research Institute (GRI) Tight Gas Sands Research Program. Data of this type can be invaluable to anyone designing a hydraulic fracture treatment in a complex, multi-layered reservoir. Correlations are presented that allow the in-situ stress gradient to be calculated from openhole log data as a function of reservoir pressure. Results from thirty-four (34) stress tests in five wells in the Travis Peak formation of east Texas are presented. Twenty of these tests were conducted as part of the 1986 GRI Staged Field Experiment in the Waskom (Travis Peak) Field in Harrison County, Texas. The primary purpose of these tests was to determine the in-situ stresses of the various lithologies in this multi-layered, complex reservoir.

**36455 Pressure transient response in multilayer gas reservoirs containing hydraulic fractures.** Sullivan, R.B.; Lee, W.J.; Holditch, S.A. (S.A. Holditch and Associates Inc.). pp 91-102 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16399.

This paper presents a method to estimate induced fracture properties and reservoir geometry in multilayered gas reservoirs similar to the Travis Peak formation in East Texas. The Travis Peak is characterized by commingled production from small, high-permeability channel sands and blanket low permeability formations. The specific objectives are to estimate fracture half-length, fracture conductivity, and area of the small, high-permeability layer in a two-layer reservoir system similar to the Travis Peak. In this study, the authors developed constant rate drawdown type curves applicable for analyzing pressure buildup tests which follow production at constant bottomhole pressure. The results obtained from our type curves are used only as a starting point for a more rigorous numerical simulation (history-matching) study.

**36456 Transient pressure behavior of multiple-fractured gas wells.** Choo, Y.K.; Wu, C.H. (Improved Petroleum Recovery Inc.). pp 73-90 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16398.

Virtually all studies on transient pressure behavior of fractured gas wells assumed a single fracture of equal half-length emanating from the opposites sides of the wellbore. However, multiple fractures may result from explosive, tailored-pulse fracturing, and hydraulic fracturing treatments. This paper presents the results of using a polar-coordinate simulator to investigate the transient pressure behavior of gas wells with 4-wing, 6-wing, and 8-wing multiple fractures.

**36457 Case history of hydraulic fracture performance in the naturally fractured Paludal zone: The transitory effects of damage.** Branagan, P.T.; Cipolla, C.L.; Lee, S.J.; Yan, L. (CER Corp.). pp 61-72 of Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870529—).

From Society of Petroleum Engineers meeting on low permeability reservoirs; Denver, CO, USA (18 May 1987).

SPE/DOE 16397.

The pre- and post-simulation reservoir performance of two naturally fractured Paludal sandstones in the Mesaverde Group were thoroughly tested and evaluated. The transitory nature and effects of natural fracture damage caused by two stimulation experiments are illustrated. These two sandstone reservoirs, located at the Department of Energy (DOE) Multiwell Experiment (MWX) site, designated Paludal sands 3 and 4, were initially characterized by integrating a comprehensive set of core, log, seismic, geological, well testing and production data. The data set indicated that the dominant production mechanism in Paludal sands 3 and 4 was a set of

anisotropic natural fractures. The identification, quantification and incorporation of this anisotropic natural fracture system is critical to the subsequent post-fracture production and well test analysis.

## 0320 Transport, Pipelines, And Handling

*REFER ALSO TO CITATION(S) 36426, 37499*

36458 **(PB—87-181962/XAB) Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986.** Thompson, N.G.; Ruck, G.T.; Walcott, K.J.; Koch, G.H. (Battelle Columbus Div., OH (USA)). Mar 1987. 151p. NTIS, PC A08/MF A01.

See also PB—85-169324.

Cathodic protection (CP) is typically used on underground steel gas piping to control corrosion. The research in Phase IVA of the program examined in detail pipe-to-soil potential waveforms for cathodically protected pipelines. Based on these waveforms, several techniques based on waveform analysis were examined for measuring off-potentials on pipelines protected by impressed-current CP systems. Prototype instruments developed include a pulse-generator instrument (PG) and a waveform analyzer (WFA) instrument. Results of field experiments demonstrated that the Waveform Analyzer/Pulse Generator system accuracy was within 10% of the values obtained by conventional current-interruption techniques for 90% of the values measured in the field. In addition (Phase IVB), the feasibility was shown for using AC-impedance methods for monitoring the level of CP for either sacrificial-anode or impressed-current CP systems.

36459 **New techniques to minimize environmental impact to right-of-way during pipeline construction.** Gaynor, A.J.; Altpeter, L.L. Jr.; Carter, R.P. (Argonne National Lab.). pp 504-506 of American Gas Association 1986 operating section proceedings. Arlington, VA; American Gas Association (1986). (CONF-8604218—).

From American Gas Association: distribution/transmission conference; Chicago, IL, USA (28 Apr 1986).

86-DT-124.

A research program was initiated in early 1983 by the Gas Research Institute at Argonne National Laboratory to conduct selected field and laboratory research activities that will provide the natural gas transmission industry with cost-effective options to mitigate ecological impacts and minimize reclamation costs of pipeline installation. The program is based on the results of a survey of 20 gas transmission companies to define needed environmental research associated with installation and maintenance of gas transmission pipelines. The assessment study identified four areas in which research could benefit the industry: monitoring recovery of agricultural lands, monitoring recovery of rivers and streams following pipeline installation, evaluating soil erosion control techniques, and investigating means for improving pipeline installations in Gulf Coast wetlands. To date, five field research projects have begun in conjunction with pipeline construction projects. A bibliography of selected publications related to disturbance caused by pipeline installation has been completed. The project initiated to monitor construction impacts of a pipeline river crossing in central Ohio has been completed, and a final report is available. It is planned that wetlands research will commence early in 1987.

## 0330 Properties

*REFER ALSO TO CITATION(S) 36430*

36460 **(PB—87-181970/XAB) Kinetics of chemisorption and gasification reactions of carbon for evaluation of the role of electron-transfer processes. Annual report, January-December 1986.** Richards, G.N.; DeGroot, W.F. (Montana Univ., Missoula (USA). Wood Chemistry Lab.). Jan 1987. 51p. NTIS, PC A04/MF A01.

The research represents the first comprehensive study of relative rates of reactions of different gases using a single well-defined carbon. Gasification was carried out in a miniature reactor designed to provide precise control of reaction conditions. Reaction rates determined in different temperature ranges were extrapolated to a single temperature for comparison of relative rates of reaction. Relative reaction rates for the gasification of cellulose char in $CO_2$, $O_2$ and $H_2O$ were found to be 1.0, 1.3 x 10 to the 4th power and 9.5, respectively; apparent activation energies for the same reaction were 64.4, 26.7, and 48.3 kcal/mole. The results of this study, along with existing data for other types of carbon, will allow more meaningful comparison of relative rate data to fundamental chemical parameters of the reactant gases as a means of deducing the specific chemical steps which contain the rates of gasification reactions.

## 0340 Combustion

*REFER ALSO TO CITATION(S) 37500*

36461 **(AD-A—179337/1/XAB) Parametric investigation of soot behavior and other emissions in a gas-turbine combustor. Master's thesis.** Weller, J.D. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1984. 48p. NTIS, PC A03/MF A01.

An investigation was conducted to determine the effects of operating characteristics and fuel additives in a gas-turbine combustor on particulates (soot) and other gaseous emissions (NOx, NO). The principles of Mie theory and three-wavelength light transmittance were utilized in this investigation to determine particulate size and mass concentration. Using an Allison T63 turboshaft engine combustor, five experimental fuels of varying chemical composition were analyzed from an emissions standpoint. There was no apparent relationship between particulate size and either fuel composition or combustor exhaust temperature. Nitric oxide levels were indifferent to fuel composition but did show a characteristics upward trend with exhaust temperature. Visible-spectrum transmittance did indicate an inverse relation to increasing exhaust temperature. Though only two fuel additives were tested on one fuel, there was no manifestation of improved transmittance with their use.

36462 **(N—87-20514) Simplified method for determining heat of combustion of natural gas.** Singh, J.J.; Chegini, H.; Mall, G.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1987. 15p. (NASA-TP—2682; L—16261; NAS—1.60:2682). NTIS, PC A02/MF A01.

A simplified technique for determination of the heat of combustion of natural gas has been developed. It is a variation of the previously developed technique wherein the carrier air, in which the test sample was burnt, was oxygen enriched to adjust the mole fraction of oxygen in the combustion product gases up to that in the carrier air. The new technique eliminates the need for oxygen enrichment of the experimental mixtures and natural gas samples and has been found to predict their heats of combustion to an uncertainty of the order of 1 percent.

36463 **(PB—87-184305/XAB) Development of an advanced gas-fired furnace for high-temperature heating of continuously cast thin-section steel products. Final report, January-December 1986.** Franz, D.G. (Bricmont and Associates, Inc., McMurray, PA (USA)). Jan 1987. 171p. (REPT—680). NTIS, PC A08/MF A01.

The project involved the development of preliminary design parameters for two different types of gas-fired furnaces capable of reheating thin sections (i.e., 1-inch thick) of continuously cast steel. These reheated thin steel sections are sent directly into with Hot Strip Mill finishing stands without further reductions. For the Hot Strip Mill configurations where a thin section continuous caster may be close coupled in-line with the finishing stands, a roller hearth furnace was developed. This furnace was designed to reheat the as-cast thin section in flat form at a production rate of 250 tons/hour. For the Hot Strip Mill configuration where a thin section caster may have to be located remote from the finishing stands, a car bottom furnace was developed. This furnace was designed to reheat the thin section in coiled form at a production rate of 125 tons/hour. Either of these thin section reheat furnaces will require only 32% of the fuel requirement of existing reheat furnace operations that process continuously cast steel slabs.

36464 **(PB—87-184313/XAB) Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986.** Chou, G.F.; Prausnitz, J.M. (California Univ., Berkeley (USA). Dept. of Chemical Engineering). Jan 1987. 24p. NTIS, PC A02/MF A01.

See also report for 1984-1985, PB—86-178985.

A thermodynamic framework has been developed for multistage adiabatic flash calculations of complex mixtures using continuous thermodynamics. This framework is an extension of that for single-stage flash calculations reported earlier (GRI-85/0242). The multistage framework is applied to an absorber for recovering intermediate hydrocarbons from natural gas. The lean oil used for the absorption process is a continuous mixture of heavy paraffins. The amount of solvent loss calculated using continuous thermodynamics compares favorably with that calculated using the exact method where all components are considered in the calculation. By contrast, the pseudocomponent method may underpredict the correct amount of solvent loss by 50%. A thermodynamic framework is proposed for improving an equation of state for phase-equilibrium calculations near the vapor-liquid critical region.

# 04 OIL SHALES AND TAR SANDS

## 0403 Drilling, Fracturing, And Mining

36465 **(PB—87-174918/XAB) Improved stopping, door, and overcast construction for oil-shale mines. Open File report, June 1984-September 1986.** Adam, M.E.; Brechtel, C.E.; Agapito, J.F.T. (Agapito (J.F.T.) and Associates, Grand Junction, CO (USA)). Sep 1986. 186p. NTIS, PC A09/MF A01.

The report describes the construction and testing of large (30-ft-high by 55-ft-wide) stopping and overcast structures in an oil-shale mine. The work was undertaken to develop construction techniques and cost data, and to measure leakage rates on full-scale structures in an oil-shale mine. A design data base was developed by reviewing industry practice, oil shale industry plans, and technical literature. Alternate layouts for room-and-pillar mining were examined to find ways to reduce the size and number of ventilation control structures. Six full-size stoppings and one overcast structure were built at the Colony Pilot Mine. Leakage rates were measured using both $SF_6$ tracer-gas techniques and the brattice window method. The leakage was measured both before and after a full-scale face blast. Blast air pressures were measured across two of the stoppings. Cost and leakage data were used to evaluate the projected overall performance of various combinations of the stoppings in a two-panel oil-shale mine.

36466 **(SAND—86-2883C) Confined volume blasting experiments: Description and analysis.** Gorham-Bergeron, E.; Kuszmaul, J.S.; Bickel, T.C.; Shirey, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-870867—3). NTIS, PC A02. File Number DE87009499.

From 2. international symposium on rock fragmentation by blasting; Keystone, CO, USA (23 Aug 1987).

A series of bench-scale blasting experiments was conducted to produce rubble beds for use in retorting experiments. The experiments consisted of blasting oil shale with explosives within a confined volume containing 25% void. A variety of blasting geometries was used to control the fragment size distribution and void distribution in the rubble. The series of well controlled tests provided excellent data for use in validating rock fragmentation models. Analyses of the experiments with PRONTO, a dynamic finite element computer code, and a newly developed fracturing model provided good agreement between code predictions and experimental measurements of fracture extent and fragment size. CAROM, a dynamic distinct element code developed to model rock motion during blasting, was used to model the fully fragmented tests. Calculations of the void distribution agreed well with experimentally measured values. 9 refs., 11 figs., 1 tab.

36467 **(SAND—86-2884C) A new constitutive model for fragmentation of rock under dynamic loading.** Kuszmaul, J.S. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 13p. (CONF-870867—1). NTIS, PC A02. File Number DE87009501.

From 2. international symposium on rock fragmentation by blasting; Keystone, CO, USA (23 Aug 1987).

A constitutive model for rock subjected to blast-induced fracturing is introduced. When the rock experiences tensile loading, microcracking occurs, which degrades the material stiffness. The model includes an effect that occurs at high densities of microcracks: the zones of stress-relieved material around microcracks can overlap. In compression, the rock response is elastic, perfectly plastic. The constitutive model is compared to an earlier model using a simple problem involving loading to failure of a sample of rock under constant strain rate. The new model predicts this failure to be sudden or brittle, as is expected for rocks. The model is also applied to a single-blastwell cratering test in oil shale. The model is used to calculate the extent of fragmentation and the particle sizes of the rubble. The model provides an excellent prediction of the experiment. 16 refs., 6 figs., 3 tabs.

## 0404 Oil Production, Recovery, And Refining

*REFER ALSO TO CITATION(S) 36466, 36475, 36477*

36468 **(DOE/FE/60177—2365) Reverse combustion in asphalt ridge tar sand.** Romanowksi, L.J. Jr.; Thomas, K.P. (Western Research Inst., Laramie, WY (USA)). Apr 1985. Contract FC21-83FE60177. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011848.

One-dimensional laboratory experiments were conducted to evaluate reverse combustion both as a recovery process and as a reservoir preheating mechanism before steam displacement. Pairs of similarly packed tubes were subjected to identical reverse combustion conditions, and one packed tube of each pair was subsequently steamflooded. Reverse combustion effectively preheated the tar sand without developing matrix plugging. Peak combustion temperatures increased with increased air flux and ranged from 600° to 1050°F (316-566°C). Oil yields averaged 33 wt. % of the initial bitumen and wre independent of injected air fluxes between 50 and 100 scfh/ft$^2$. The fuel consumption averaged 24 wt. % of the initial bitumen, and most of the remaining bitumen was converted into an unrecoverable coke (33 wt. % initial bitumen). Consequently, very little bitumen or oil (less than 10 wt. % initial bitumen) was available for recovery during the subsequent steamflood phase. Coking occurred at temperatures as low as 400-450°F (200-230°C), and tar sand ignition occurred at approximately 600°F (315°C). Low-temperature oxidation reactions were dominant prior to ignition and were characterized by low levels of carbon oxides in the product gas, increased apparent hydrogen/carbon ratio in the combustion products, increased water production, increased acidity in the product water, and increased oxygen in the product oil. The quality of the reverse combustion product oil was significantly better than the original bitumen. The API gravity increased from 10.6° (bitumen) to 21.2° API, and the viscosity at 140°F (60°C) decreased three orders of magnitude from 12,800 cp for the bitumen to 18 cp for the product oil. 12 refs., 5 figs., 6 tabs.

36469 **(DOE/FE/60177—2375) Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting.** Guffey, F.D.; Cummings, R.E. (Western Research Inst., Laramie, WY (USA)). Sep 1985. Contract FC21-83FE60177. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012681.

The possibility of developing separate diagnostic correlations for cracking and combustion was evaluated using shale oils produced in a laboratory reference retort. The shale oils were produced under rotating conditions in which coking and cracking losses were minimized so that changes in possible combustion indicators could be observed. The changes in the concentration of phenol and methyl-substituted phenols relative to the concentration of selected hydrocarbons were compared with the concentration of oxygen available for combustion of the produced oil. The change in the concentration of phenol relative to the sum of n-undecane and

n-dodecane (phenol/n-undecane + n-dodecane ratio) correlated well with the oxygen concentration for experiments performed at a retort heating rate of 1.9°C/min (3.4°F/min). A correlation of the phenol/n-undecane + n-dodecane ratio with the available oxygen was not observed for oils produced at a retort heating rate of 25.7°C/min (46.3°F/min). This result may have been caused by slightly more cracking of the normal alkanes at the faster heating rate. The possible use of phenol as an indicator of combustion still exists even with the discrepancy in the correlation of the phenol/n-undecane + n-dodecane ratio with oxygen concentration at the faster retort heating rate. 5 refs., 1 fig., 3 tabs.

36470 **(UCID—16986-87) Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987.** Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012313.

This quarterly report covers: (1) isomerization of alkenes in shale oil by kaolinite; (2) oil shale enthalpy reactions; (3) simulation of fluid-bed pyrolyzer/lift-pipe combustor retort; and (4) yields from the cross-swept, packed-bed pyrolyzer. Study on oil shale enthalpy reactions includes work on heat of pyrolysis of Green River shale at 500°C after rapid heating, summary of enthalpy relations of Green River shale and eastern shale enthalpy relations. 6 figs., 5 tabs. (AT)

36471 **Application of laboratory results to the design of a high yield VMIS oil shale retort.** Bickel, T.C.; Ricketts, T.E. New York, NY; American Institute of Chemical Engineers (1986). 21p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC04-76DP00789.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

In situ oil shale retorts have typically been designed to process a rubble bed having uniform cross-sectional rubble properties. Edge effects during rock fragmentation commonly produce increased void at the perimeter of these low-void retorts. Previous laboratory and field results have demonstrated this void variation normal to the direction of flow causes non-uniform retort front velocities that result in significantly lower oil yield. It is unlikely that process control parameters (e.g. multiple injection points, steam, etc.) can provide any significant yield improvement in these non uniform retorts. Any large improvement would come from modified rubblization concepts. This paper describes a modification to the retort blast design to achieve a uniform retorting front velocity in rubble with non-uniform properties (void fraction and particle size).

36472 **Yield optimization of an experimental retort using the ASPEN computer code.** Parkinson, W.J.; Peterson, E.J.; Phillips, T.T.; Spall, W.D.; Bachta, R. New York, NY; American Institute of Chemical Engineers (1986). 28p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The authors analyzed a product from a retorting experiment to establish a material balance. Using this material balance and the ASPEN computer code, they designed an oil shale plant around the retort.

## 0405 Properties And Composition

*REFER ALSO TO CITATION(S) 36470*

36473 **(DOE/FE/60177—2366) Organic solute profile of water from Rio Blanco Retort 1.** Poulson, R.E.; Clark, J.A.; Borg, H.M. (Western Research Inst., Laramie, WY (USA)). Dec 1985. Contract FC21-83FE60177. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012040.

Two water samples were taken from the Rio Blanco Oil Shale Company's Retort 1 more than three years after shutdown of the retort burn. The retort had received considerable flushing. These water samples were screened and profiled chromatographically to ascertain the character of the 20 to 30 ppM total organic carbon remaining in each. The waters were found to contain only organophilic solutes above the one-part-per-billion level. Special detection methods with part-per-billion detection limits for selected hydrophilic indicators proved negative for those indicators. Selected indicators ranged from the most hydrophilic (alkanoic acids, alkylamines, and amides) to the least (phenol). The principal species readily identified by either gas chromatography or reversed-phase liquid chromatography were the light polyalkylpyridines and the polyalkylphenols. The two principal individual compounds detected in each water were 2,4,6-trimethylpyridine and 2,3,5-trimethylphenol. The approximate concentrations of each were 200 ppb for a sample taken from the retort center and 400 ppb for a sample taken from the bottom level. It appears that there is a residual oil reservoir in the retort serving as a source of organophilic solutes. Any organic material now passing out of the retort would be highly organophilic and predisposed to deposit on even slightly hydrophobic surfaces such as oil shale or retorted oil shale. Based on the observations in this report, hydrophilic organic solutes may be presumed to be the key indicators for the interaction between oil shale in situ retort effluent and the surrounding environment. Timely monitoring of such sites and development of highly sensitive detection techniques for this class of materials would permit accurate description of migration pathways. 9 refs., 5 figs., 1 tab.

36474 **(DOE/FE/60177—2367) Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography.** Poulson, R.E.; Borg, H.M. (Western Research Inst., Laramie, WY (USA)). Mar 1986. Contract FC21-83FE60177. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012039.

A single-column ion chromatographic method was developed for separation and detection of aqueous ammonia, $C_1$-, $C_2$-, and $C_3$- alkylamines, ethanolamine, and methyldiethanolamine. A precolumn concentrator was used to take detection of ammonium ion by electrical conductivity to fractional ppB levels and detection of the organic cations to ppB levels. Analysis of ppM ammonia levels in 3 wt % alkanolamine scrubber-type solutions was possible, but resolution of alkylamines was lost. A post-column reaction system for fluorescence detection of primary amine o-phthalaldehyde derivatives with reversed-phase separation allowed amine separation in the presence of large amounts of ammonia. The same system might be used in place of concentration and conductivity for determination of the alkylamine levels. A large variety of oil shale retort by-product waters and one underground coal gasification condensate were screened for alkylamines, but none were detected. 7 refs., 8 figs., 1 tab.

36475 **(DOE/FE/60177—2368) Combined gas chromatography/mass spectrometric evaluation of selected isothermally produced shale oils.** Guffey, F.D. (Western Research Inst., Laramie, WY (USA)). Mar 1986. Contract FC21-83FE60177. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012041.

Liquid product samples generated by thermal decomposition of oil shale at 425°C for time periods ranging from 10 to 120 minutes were evaluated using combined gas chromatography/mass spectrometry. This research effort was undertaken to determine if the chemical composition of liquid products from kerogen decomposition was time dependent. Time-dependent change in the composition of the liquid products would indicate that kerogen decomposition follows reactions using intermediates of different chemical composition or structure. The results from the evaluation of the liquid products show more similarities than differences in chemical composition. This observation indicates that kerogen decomposition probably does not follow time-dependent reaction pathways using reaction intermediates of different chemical composition or structure. The minor differences noted in the samples do appear to be related to the time variable of the thermal decomposition experiments. 7 refs., 2 figs., 5 tabs.

### 0407 Health And Safety

**36476 (LMF—115, pp 273-282) Inhalation exposure of rats to oil shale dust and diesel exhaust.** Mauderly, J.L.; Barr, E.B.; Bice, D.E.; Eidson, A.F.; Henderson, R.F.; Jones, R.K.; Pickrell, J.A.; Wolff, R.K. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

life span inhalation exposures of rats 7 h/day, 5 days/wk for up to 30 mo to 5 mg/m$^3$ of raw or retorted (spent) oil shale dusts, alone or in combination with diesel exhaust at 3.5 mg soot/m$^3$ have been completed. Exposures did not affect body weight or survival. Exposures to raw or spent shale alone caused few health effects. Diesel exhaust exposures caused effects which were amplified in both diesel-shale groups. These effects consisted of a chronic inflammation resulting in increased lung density and a restrictive respiratory function disorder. Information at hand suggests that the effects of diesel and shale are synergistic. Evaluations of lung burdens of particles, clearance of radiolabeled particles, lung connective tissue, histopathology, and carcinogenicity are in progress. 7 references, 1 figure, 2 tables.

### 0408 Marketing And Economics

*REFER ALSO TO CITATION(S) 36477, 36978*

### 0409 Waste Research And Management

*REFER ALSO TO CITATION(S) 36473, 36474*

### 0410 Environmental Aspects

*REFER ALSO TO CITATION(S) 36337*

**36477 (DOE/LC/11067—2235-Vol.2) Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2.** (Cliffs Engineering, Inc., Rifle, CO (USA)). Dec 1986. Contract FG21-85LC11067. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001040.

Volume II covers: environmental impacts resulting from the construction and operation of a five hundred barrel per day demonstration oil shale retort and its facilities and infrastructure; market analysis for Indiana shale oil; and socioeconomic assessment. (ATT)

## 05 NUCLEAR FUELS

### 0501 Reserves, Exploration, And Mining

**36478 (PNL-SA—14499) Uranium in selected endorheic basins as partial analogue for spent fuel behavior in salt.** Van Luik, A.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 13p. (CONF-8704158—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011186.

From Symposium on waste management; Brussels, Belgium (28 Apr 1987).

If uranium (U) behavior with respect to the components of certain endorheic (closed) basin subsurface, playa, or terminal lake brines were quantitatively understood, the ability to predict the long-term redistribution of emplaced U among analogous components of salt formations may be enhanced. Tests that determine the nature of U interactions with pure mineral and organic matter surfaces are important, but studying the natural systems available could give indications of long-term stabilities of processes, and of preferential processes. For example, some metals present in trace quantities, such as U, may be coprecipitated in the oxidized zone with an evaporite mineral that may afterward undergo diagenesis, especially if conditions become more reducing. During diagenesis, the trace metal may be remobilized, but scavenged by sulfides or organic particulates, leaving the evaporite mineral depleted of its trace metal content. A survey of the literature shows trace metal behavior in closed basins has been studied. However, information on U consists of only a few abundance determinations for some evaporite systems. Obtaining and interpreting natural analogue data for the U and Th decay series in selected endorheic basin environments is suggested. 44 refs., 3 figs.

### 0505 Uranium Enrichment

**36479 (K/TS—11-869) System design description for the CPDF [Centrifuge Plant Demonstration Facility] electric power system: SDD-9.** (Science Applications, Inc., Oak Ridge, TN (USA)). Jun 1987. Contract AC05-84OT21400. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010226.

The Centrifuge Plant Demonstration Facility (CPDF) Electric Power System provides electric power necessary to support CPDF machine, process system and support system operation. In performing this function, the Electric Power System receives power from two Oak Ridge Gaseous Diffusion Plant (ORGDP) feeders and supplies it to normal loads via two separate electric power distribution systems and one centrifuge drive power distribution system. Two automatic-starting diesel generators and a continuously operating uninterruptible power supply (UPS) provide power for necessary emergency loads in the event of loss of offsite power.

**36480 (PB—87-188991/XAB) Mortality among uranium enrichment workers.** Brown, D.P.; Bloom, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1987. 55p. NTIS, PC A04/MF A01.

A retrospective cohort mortality study was conducted on workers at the Portsmouth Uranium Enrichment facility in Pike County, Ohio, in response to a request from the Oil, Chemical and Atomic Workers International Local 3-689 for information on long-term health effects. Primary hazards included inhalation exposure to uranyl fluoride containing uranium-235 and uranium-234, technetium-99 compounds, and hydrogen-fluoride. Uranium-238 presented a nephrotoxic hazard. Statistically significant mortality deficits based on U.S. death rates were found for all causes, accidents, violence, and diseases of nervous, circulatory, respiratory, and digestive systems. Standardized mortality rates were 85 and 54 for all malignant neoplasms and for other genitourinary diseases, respectively. Deaths from stomach cancer and lymphatic/hematopoietic cancers were insignificantly increased. A subcohort selected for greatest potential uranium exposure has reduced deaths from these malignancies. Insignificantly increased stomach cancer mortality was found after 15 years employment and after 15 years latency. Routine urinalysis data suggested low internal uranium exposures.

**36481 (UCRL—96314) An overview of copper-laser development for isotope separation.** Warner, B.E. (Lawrence Livermore National Lab., CA (USA)). 13 Mar 1987. Contract W-7405-ENG-48. 13p. (CONF-870132—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011557.

From LASE-13: pulse power for lasers conference; Los Angeles, CA, USA (11 Jan 1987).

We have developed a copper-laser pumped dye-laser system that addresses all of the requirements for atomic vapor laser isotope separation. The requirement for high average power for the laser system has led to the development of copper-laser chains with injection-locked oscillators and multihundred-watt amplifiers. By continuously operating the Laser Demonstration Facility, we gain valuable data for further upgrade and optimization.

**36482 Finite element analysis of flow in a gas-filled rotating annulus.** Berger, M.H. (Oak Ridge National Lab., TN, USA). *International Journal for Numerical Methods in Fluids;* 7: No. 3, 215-231(Mar 1987). Contract AC05-84OR21400.

Linearized multidimensional flow in a gas centrifuge can be described away from the ends by Onsager's pancake equation. However, a rotating annulus results in a slightly different set of boundary conditions from the usual symmetry at the axis of rotation. The problem on an annulus becomes ill-posed and requires

some special attention. Herein we treat axially linear inner and outer rotor temperature distributions and velocity slip. An existence condition for a class of non-trivial, one-dimensional solutions is given. New exact solutions in the infinite bowl approximation have been derived containing terms that are important at finite gap width and non-vanishing velocity slip. The usual one-dimensional, axially symmetric solution is obtained as a limit. Our previously reported finite element algorithm has been extended to treat this new class of problems. Effects of gap width, temperature and slip conditions are illustrated. Lastly, we report on the compressible, finite length, circular Couette flow for the first time.

36483 **Computer-extended series for a source/sink driven gas centrifuge.** Berger, M.H. (Oak Ridge National Lab., TN, USA). *International Journal for Numerical Methods in Fluids;* 7: No. 3, 233-246(Mar 1987). Contract AC05-84OR21400.

We have reformulated the general problem of internal flow in a modern high speed gas centrifuge with sources and sinks in such a way as to obtain new, simple, rigorous closed form analytical solutions. Both symmetric and antisymmetric drives lead us to an ordinary differential equation in place of the usual inhomogeneous Onsager partial differential equation. Owing to the difficulties of exactly solving this sixth order, inhomogeneous, variable coefficient ordinary differential equation we appeal to the power of perturbation theory and techniques. Two extreme parameter regimes are identified, the so-called semi-long bowl approximation and a new short bowl approximation. Only the former class of problems is treated here. The long bowl solution for axial drive is the correct leading order term, just as for pure thermal drive. New 0(1) results are derived for radial, drag and heat drives in two dimensions. Then regular asymptotic, even ordered power series expansions for the flow field are carried out on the computer to O (epsilon$^4$) using MACSYMA. These approximations are valid for values of epsilon near unity. In the spirit of Van Dyke, one can carry out this expansion process, in theory, to apparently arbitrary order for arbitrary but finite decay length ratio. Curiously, the flows induced by axial and radial forces are proportional for asymptotically large source scale heights, chi*. Corresponding isotope separation integral parameters will be given in a companion paper.

## 0507 Fuels Production And Properties

36484 **(RFP—4105) Design and evaluation of plutonium electrorefining cells.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 29p. (CONF-870661—1). NTIS, PC A03. File Number DE87011053.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

A plutonium electrorefining cell was designed for stationary furnace operation. This cell and the LANL electrorefining cell were evaluated. Results of this evaluation and comparison to existing production electrorefining at Rocky Flats are presented.

## 0508 Spent Fuels Reprocessing

36485 **(DP-MS—86-164) Canyon solvent cleaning.** Reif, D.J. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 21p. (CONF-8610156—3-Abst.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011251.

From Plutonium/uranium chemical recovery operations conference; Aiken, SC, USA (14 Oct 1986).

The HM Process at the Savannah River Plant (SRP) uses 7.5% tributylphosphate in n-paraffin as an extraction solvent. During use, the solvent is altered due to hydrolysis and radiolysis, forming materials that influence product losses, produce decontamination, and separation efficiencies. Laboratory studies to improve online solvent cleaning have shown the carbonate washing, although removing residual solvent activity does not remove binding ligands that hold fission products in the solvent. Treatment of solvent by an alumina adsorption process removes binding ligands and significantly improves recycle solvent performance. Both laboratory work defining a full-scale alumina adsorption process and the use of the process to clean HM Process first cycle solvent are presented.

36486 **(DP-MS—87-9) Canyon solvent cleaning with solid adsorbents.** Reif, D.J. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 34p. (CONF-870661—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011244.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

The HM Process at the Savannah River Plant (SRP) uses 7.5% tributyl phosphate in n-paraffin as an extraction solvent. During use, the solvent is altered due to hydrolysis and radiolysis, forming materials that influence product losses, product decontamination, and separation efficiencies. Laboratory studies to improve online solvent cleaning have shown that carbonate washing, although removing residual solvent activity, does not remove binding ligands that hold fission products in the solvent. Treatment of solvent with a solid adsorbent removes binding ligands and significantly improves recycle solvent performance. Both laboratory work defining a full-scale adsorption process and the use of the process to clean HM Process first cycle solvent are presented.

36487 **(DP-MS—87-55) Comparison of laboratory and plant mixer-settlers.** Holt, D.L.; Graham, F.R. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 21p. (CONF-870661—8-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011180.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

Savannah River Plant uses mixer-settlers to recover and purify enriched uranium from fission products. Possible flowsheet improvements to yield better fission product decontamination will be investigated using laboratory-scale mixer-settlers. Laboratory-scale and actual plant-scale mixer-settlers were compared to determine whether experimental results obtained in the laboratory were applicable to plant processes. Parameters compared were: per-stage residence time, mixing intensities, and organic-to-aqueous ratios in the mixer-settlers' mixing sections. These results are presented along with descriptions of the laboratory facilities which will contain the mixer-settlers. The facilities were designed to contain the solvent extraction equipment in a contaminated environment and allow for flowsheet development using plant solutions.

36488 **(ORNL/TM—10359) Consolidated Fuel Reprocessing Program: Progress report for period October 1 to December 31, 1986.** Groenier, W.S.; Meacham, S.A.; Stradley, J.G. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011953.

All research and development (R and D) on civilian power reactor oxide fuel reprocessing in the United States is managed under the Consolidated Fuel Reprocessing Program (CFRP) centered at Oak Ridge National Laboratory (ORNL). A prime focus of present work is on technical exchanges and collaboration with other countries. In this context, the US Department of Energy (DOE) is in the process of negotiating a major collaboration with Japan. Both work associated with the foreign exchanges and collaboration and some on-going work are reported in overview fashion in this series of quarterly progress reports.

36489 **(PNL—6261) Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification.** Scheele, R.D.; Burger, L.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012500.

To determine the bed-loading capacities and the effluent iodine concentrations at normal, off-normal, and standby conditions, PNL performed a series of statistically designed parametric tests using a bed of AgZ 12 cm long x 1 cm diameter. In addition, tests were performed to determine the effect of bed length, the effect of a second bed, the effect of extended standby conditions, and the efficiency of hydrogen-reduced AgZ (Ag°Z). Results of these experiments are presented in this report.

36490 **(RFP—4106) Aqueous methods for recovery of plutonium from pyrochemical residues.** Muscatello, A.C.; Killion, M.E.; Fisher, D.C. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 4 May 1987. Contract AC04-76DP03533. 27p. (CONF-870661—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011054.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

Studies of the recovery of plutonium from the pyrochemical residue salts from the Direct Oxide Reduction (DOR) and Electrorefining (ER) processes have shown that chloride anion exchange is useful and effective. Our previous studies have defined the operating limits for obtaining low level effluent plutonium losses on the order of $10^{-3}$ g/l. The knowledge obtained in work on DOR salt was extended to ER salt and a process has been demonstrated to be feasible on a larger scale. Studies of oxalate precipitation of plutonium (III) from the eluat exhibit the expected losses to the filtrate as a function of the acidity. Two alternatives to chloride anion exchange, caustic leaching and direct oxalate precipitation are also shown to be feasible for the recovery of plutonium from ER salts. The results of studies of coprocessing DOR and ER residue salts to increase ER salt throughput and decrease HCl requirements are also presented. The feasibility of coprocessing other pyrochemical residues, such as black salts, anode heel, and ER scrapeout will be discussed.

36491 **(RFP—4128) [Small scale direct oxide reduction (DOR) experiments].** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 32p. (CONF-870661—3). NTIS, PC A03. File Number DE87011049.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

Objectives were to provide process design information to the Plutonium Recovery Project and to produce DOR (direct oxide reduction) product which meets Foundry purity specifications and Oh-0 Foundry specifications.

## 0509 Transport And Storage

*REFER ALSO TO CITATION(S) 37465*

36492 **(DOE/OR/21495—T1) Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure.** Glakpe, E.K. (Howard Univ., Washington, DC (USA). Dept. of Mechanical Engineering). Jul 1986. Contract FG05-84OR21495. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009956.

Natural convection heat transfer from a body to a finite space that surrounds it has received extensive attention in recent years. Application areas in which natural convection plays an important role in the overall exchange of energy include the design of nuclear reactors, the design of casks for the transportation of spent fuel assemblies, the cooling of electronic equipments, heat transfer in aircraft cabin insulation systems, and thermal storage systems. Both numerical and experimental studies have been made on natural convection heat transfer about relatively simple, but not necessarily easy, flow configurations for which convenient natural coordinate systems exist. However, very few studies of natural convection in and around complex geometries have been made. The present methodology can be applied to a class of natural convection problems in a horizontal circular enclosure where the inner boundary does not lie along a coordinate line. The results obtained with the present method for a concentric cylinders' problem is in good agreement with the previous results obtained by Kuehn and Goldstein. Furthermore, the results obtained for the natural convection problem around a square rod in a circular horizontal cylinder is also in good agreement with results obtained by Chang et al. The present results obtained are applicable only to a dry cask. However, by changing the Prandtl number, results for fluids other than air can be obtained. Furthermore, with the appropriate definition of the function I, the configuration studied experimentally by Boyd can also be obtained. The present methodology is limited to two dimensional problems. However, the method can be extended to three dimensions with no difficulty.

36493 **(PNL—6162) Rod consolidation of RG and E's [Rochester Gas and Electric Corporation] spent PWR [pressurized water reactor] fuel.** Bailey, W.J. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011698.

The rod consolidation demonstration involved pulling the fuel rods from five fuel assemblies from Unit 1 of RG and E's R.E. Ginna Nuclear Power Plant. Slow and careful rod pulling efforts were used for the first and second fuel assemblies. Rod pulling then proceeded smoothly and rapidly after some minor modifications were made to the UST and D consolidation equipment. The compaction ratios attained ranged from 1.85 to 2.00 (rods with collapsed cladding were replaced by dummy rods in one fuel assembly to demonstrate the 2:1 compaction ratio capability). This demonstration involved 895 PWR fuel rods, among which there were some known defective rods (over 50 had collapsed cladding); no rods were broken or dropped during the demonstration. However, one of the rods with collapsed cladding unexplainably broke during handling operations (i.e., reconfiguration in the failed fuel canister), subsequent to the rod consolidation demonstration. The broken rod created no facility problems; the pieces were encapsulated for subsequent storage. Another broken rod was found during postdemonstration cutting operations on the nonfuel-bearing structural components from the five assemblies; evidence indicates it was broken prior to any rod consolidation operations. During the demonstration, burnish-type lines or scratches were visible on the rods that were pulled; however, experience indicates that such lines are generally produced when rods are pulled (or pushed) through the spacer grids. Rods with collapsed cladding would not enter the funnel (the transition device between the fuel assembly and the canister that aids in obtaining high compaction ratios). Reforming of the flattened areas of the cladding on those rods was attempted to make the rod cross sections more nearly circular; some of the reformed rods passed through the funnel and into the canister.

36494 **(PNL—6189) Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas.** Levy, I.S.; Chin, B.A.; Simonen, E.P.; Beyer, C.E.; Gilbert, E.R.; Johnson, A.B. Jr. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 102p. NTIS, PC A06/MF A01; GPO Dep. File Number DE87011996.

It is concluded that the recommendation of a single-valued temperature limit of 380°C should be replaced by multiple limits to account for variations in fuel design, burnup level, spent fuel age, and storage cask design. A single-valued limit to account for these factors would, in some situations, impose unnecessary conservatisms and, potentially, economic penalties for utilities and storage cask vendors. The technical validity and conservatism of the CSFM model should assure acceptance by the NRC for utility and cask vendor use.

36495 **Developing a national system for transporting high-level nuclear waste.** Barrett, L.H. (Transportation and Waste Systems Div., Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Washington, DC). pp 107-112 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The federal government is developing a national transportation system to ship spent fuel from commercial nuclear power plants and high-level radioactive waste from defense activities to a permanent, geologic repository. Technically, this task is fairly straightforward. But institutionally, it is one of the most complex ever undertaken by the federal government. This paper describes the chief features of this transportation system and the unique management challenges it presents.

## 0520 Waste Management

*REFER ALSO TO CITATION(S) 36553, 37347, 37818, 37854, 38043, 38046*

36496 **(BMI/ONWI—636) Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany.** Coyle, A.J.; Kalia, H.N.; Eckert, J.L. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Apr 1987. Contract AC02-83CH10140. 263p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87010239.

The second quarterly brine migration data report describes experiments simulating a nuclear waste repository at the 800-m (2624-ft) level of the Asse Salt Mine in the Federal Republic of Germany from May 1983 through December 1983. This report describes the test equipment, the Asse Salt Mine, and the pretest properties of the salt in the test gallery. This report also includes test data for the first 7 months of operations on brine migration rates, borehole pressure, salt temperatures, and thermomechanical behavior of the salt. The duration of the experiments will be approximately 2 years, ending in December 1985.

36497 **(BMI/ONWI—643) Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany.** Eckert, J.L.; Coyle, A.J.; Kalia, H.N. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 270p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87011694.

The fourth quarterly brine migration data report describes experiments simulating a nuclear waste repository at the 800-m (2624-ft) level of the Asse Salt Mine in the Federal Republic of Germany from May 1983 through June 1984. This report describes the test equipment, the Asse Salt Mine, and the pretest properties of the salt in the test gallery. This report also includes test data for the first 13 months of operations on brine migration rates, borehole pressure, salt temperatures, and thermomechanical behavior of the salt. An annual report has been prepared for the year 1983 describing the test activities on a yearly basis (Rothfuchs et al., 1984). The duration of the experiments will be approximately 2 years, ending in December 1985. 1 ref., 124 figs., 91 tabs.

36498 **(BMI/ONWI—646) Comparison of results for ten analytical heat conduction problems as solved by the general heat transfer code HEATING5 [Heat Engineering and Transfer in Nine Geometries].** Insalaco, J.W. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jul 1987. Contract AC02-83CH10140. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012321.

This report documents the results of the verification effort recently completed for the general heat conduction code HEATING5. Objective was to verify HEATING5 for use in estimating the temperature distribution around a waste package after it is emplaced in a repository. The approach taken in verifying HEATING5 was to compare the solutions obtained with HEATING5 to the analytical solutions for a series of problems for which analytical solutions existed. Ten analytical problems and one sample problem from the original source of HEATING5, the Radiation Shielding and Information Center, were chosen to verify HEATING5's capability to solve steady-state and transient heat conduction, including problems with an applied surface temperature or heat flux, constant or time-dependent thermal conductivity, and constant or time-dependent heat generation. This study did not attempt to verify HEATING5 for problems that involve convection, radiation, or anisotropic thermal properties.

36499 **(BMI/ONWI—647) Verification report for SIMREP 1.1.** Tarapore, P.S. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012320.

SIMREP 1.1 is a discrete event computer simulation of repository operations in the surface waste-handling facility. The logic for this model is provided by Fluor Technology, Inc., the Architect/Engineer of the salt repository. The verification methods included a line-by-line review of the code, a detailed examination of a generated trace of all simulated events over a given period of operations, and a comparison of the simulation output results with expected values. SIMREP 1.1 performs in the required manner under the given range of input conditions.

36500 **(BNL—52042) Accelerated Leach Test(s) Program: Annual report.** Dougherty, D.R.; Pietrzak, R.F.; Fuhrmann, M.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87012307.

A computerized data base of LLW leaching data has been developed. Long-term tests on portland cement, bitumen and vinyl ester-styrene (VES) polymer waste forms containing simulated wastes are underway which are designed to identify and evaluate factors that accelerate leaching without changing the mechanisms.

36501 **(CONF-870306—61) Waste-acceptance criteria for radioactive waste disposal.** Gilbert, T.L.; Meshkov, N.K. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02. File Number DE87011518.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A method has been developed for establishing waste-acceptance criteria based on quantitative performance factors that characterize the confinement capabilities of a disposal facility for radioactive waste. The method starts from the objective of protecting public health and safety by assuring that disposal of the waste will not result in a radiation dose of any member of the general public, in either the short or long term, in excess of an established basic dose limit. A key aspect of the method is the introduction of a confinement factor that characterizes the overall confinement capability of a particular disposal facility and can be used for quantitative performance assessments as well as for establishing facility-specific waste-acceptance criteria. Confinement factors enable direct and simple conversion of a basic dose limit into waste-acceptance criteria, specified as concentration limits on rationuclides in the waste streams. Waste-acceptance criteria can be represented visually as activity/time plots for various waste streams. These plots show the concentrations of radionuclides in a waste stream as a function of time and permit a visual, quantitative assessment of long-term performance, relative risks from different radionuclides in the waste stream, and contributions from ingrowth. Application of the method to generic facility designs provides a radional basis for a waste classification system. 14 refs.

36502 **(CONF-870801—1) Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory.** McDaniel, E.W.; Weeren, H.O.; Delzer, D.B.; Sams, T.L.; Tallent, O.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010601.

From International conference on nuclear fuel reprocessing and waste management; Paris, France (24 Aug 1987).

The importance of effective waste management in the nuclear fuel cycle cannot be overestimated. At Oak Ridge National Laboratory (ORNL), development work in waste reprocessing and treatment includes the testing and use of various additives for the purpose of facilitating adherence to both process and regulatory performance criteria. Three waste reprocessing/treatment technologies and the associated materials are discussed in this paper: (1) suspension and transfer of sludge from waste storage tanks; (2) treatment to render a waste in compliance with regulatory requirements; and (3) fluoride-rich waste reprocessing. 7 refs., 3 figs.

36503 **(CONF-870812—20) Nuclear waste package fabricated from concrete.** Pfeiffer, P.A.; Kennedy, J.M. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011469.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

After the United States enacted the Nuclear Waste Policy Act in 1983, the Department of Energy must design, site, build and operate permanent geologic repositories for high-level nuclear waste. The Department of Energy has recently selected three sites, one being the Hanford Site in the state of Washington. At this particular site, the repository will be located in basalt at a depth of approximately 3000 feet deep. The main concern of this site, is contamination of the groundwater by release of radionuclides from the waste package. The waste package basically has three components: the containment barrier (metal or concrete container, in this study concrete will be considered), the waste form, and other materials (such as packing material, emplacement hole liners, etc.). The containment barriers are the primary waste container structural materials and are intended to provide containment of the nuclear waste up to a thousand years after emplacement. After the containment barriers are breached by groundwater, the packing material (expanding sodium bentonite clay) is expected to provide the primary control of release of radionuclide into the immediate repository environment. The loading conditions on the concrete container (from emplacement to approximately 1000 years), will be twofold; (1) internal heat of the high-level waste which could be up to 400°C; (2) external hydrostatic pressure up to 1300 psi after the seepage of groundwater has occurred in the emplacement tunnel. A suggested container is a hollow plain concrete cylinder with both ends capped. 7 refs.

36504 **(DOE/CH—15-1) Area Recommendation Report for the Crystalline Repository Project: Volume 1, Draft.** (USDOE Chicago Operations Office, Argonne, IL. Crystalline Repository Project Office). Jan 1986. 834p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE87012337.

This Draft Area Recommendation Report for the Crystalline Repository Project identifies portions of crystalline rock bodies as proposed potentially acceptable sites for consideration in the second high-level radioactive waste repository program. The US Department of Energy evaluated available geologic and environmental data for 235 crystalline rock bodies in the North Central, Northeastern, and Southeastern regions to identify preliminary candidate areas. Further evaluation of these preliminary candidate areas resulted in the selection of 12 as proposed potentially acceptable sites. The 12 proposed potentially acceptable sites are located in the States of Georgia (1), Maine (2), Minnesota (3), New Hampshire (1), North Carolina (2), Virginia (2), and Wisconsin (1). The data, analyses, and rationale with which the 12 proposed potentially acceptable sites were selected are presented in this draft report. The analyses presented demonstrate that the evidence available for each proposed potentially acceptable site supports (1) a finding that the site is not disqualified in accordance with the application requirements of Appendix III of the siting guidelines and (2) a decision to proceed with the continued investigation of the site on the basis of the favorable and potentially adverse conditions identified to date. Once this report is finalized, potentially acceptable sites in crystalline rock will be formally identified by the Secretary of Energy, in accordance with the DOE siting guidelines. These potentially acceptable sites will be investigated and evaluated in more detail during the area phase of the siting process. An additional eight areas, which meet the requirements for identification as potentially acceptable sites, will retain their designation as candidate areas.

36505 **(DOE/CH—15-2) Area Recommendation Report for the Crystalline Repository Project: Volume 2, Plates: Draft.** (USDOE Chicago Operations Office, Argonne, IL. Crystalline Repository Project Office). Jan 1986. 447p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE87012336.

36506 **(DOE/DP—0044) Defense Waste Management Plan for buried transuranic-contaminated waste, transuranic-contaminated soil, and difficult-to-certify transuranic waste.** (USDOE Assistant Secretary for Defense Programs, Washington, DC). Jun 1987. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011693.

GAO recommended that DOE provide specific plans for permanent disposal of buried TRU-contaminated waste, TRU-contaminated soil, and difficult-to-certify TRU waste; cost estimates for permanent disposal of all TRU waste, including the options for the buried TRU-contaminated waste, TRU-contaminated soil, and difficult-to-certify TRU waste; and specific discussions of environmental and safety issues for the permanent disposal of TRU waste. Purpose of this document is to respond to the GAO recommendations by providing plans and cost estimates for the long-term isolation of the buried TRU-contaminated waste, TRU-contaminated soil, and difficult-to-certify TRU waste. This report also provides cost estimates for processing and certifying stored and newly generated TRU waste, decontaminating and decommissioning TRU waste processing facilities, and interim operations.

36507 **(DOE/NE/44139—27) STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project.** Gates, W.E. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Jun 1987. Contract AC07-81NE44139. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011800.

The primary Supernatant Treatment System (STS) confinement barriers have sufficient reserve capacity, due to the inherent safety factors associated with this type of construction, to survive extreme environmental loading (e.g., design basis earthquake and tornado events) without structural failure and leakage of high-level wastes into the environment. The primary confinement barriers of highest reliability under earthquake and tornado loading are the reinforced concrete vaults and chambers that enclose the STS process vessels and piping. These buildings and tank vaults have been designed to higher structural safety standards than required for life safety by local building codes used in the design of industrial process plants in New York state. The radiological shielding requirements generally resulted in structural member sizes and wall thicknesses that were larger and consequently stronger than found in conventional industrial plant building design. The margin of safety against failure of the reinforced concrete barriers is conservatively estimated at 2 to 4 times the design basis earthquake. The least predictable element in the building barrier is the PVC water stop between the STS building and the shield structure on tank vault 8D-1. Tests and analysis indicate the water stop has an estimated safety factor against rupture under earthquake of 3 or greater. In terms of the internal piping and vessel systems that confine the raw supernatant in its process flow path, the connecting piping between the valve aisle, pipeway and shield structure appears to be the most vulnerable under earthquake. The safety factor for the piping appears to be on the order of 3. 26 refs.

36508 **(DOE/NE/44139—33) Decontamination of the Scrap Removal Room at the West Valley Demonstration Project.** Bridenbaker, W.A.; Clemons, L. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Feb 1987. Contract AC07-81NE44139. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011872.

This report describes the decontamination and decommissioning (D and D) of the Scrap Removal Room (SRR) at the West Valley Demonstration Project (WVDP). The SRR is an area in the former reprocessing plant that is required for use in support of D and D for other plant areas. The SRR contained a 6.8 Mg (7.5-ton) crane for loading waste material into a shielded truck cask. It became radioactively contaminated during fuel reprocessing from 1966 to 1972. This report describes the work performed to accomplish the D and D objectives of removing existing piping and equipment and of reducing radiation and contamination levels, to As-Low-As-Reasonably-Achievable (ALARA) levels for the installation of new equipment. Also reported are pre- and post-radiological conditions, personnel exposure, radioactive waste volume collected, cost and schedule data, and lessons learned.

36509 (DOE/NWTS—15, pp 26-27) **Status of geologic investigations for nuclear waste disposal at the Nevada Test Site.** Dixon, G.L.; Wilson, W.E.; Carr, W.J.; Rush, F.E.; Waddell, R.K. (US Geological Survey, Denver CO). Nov 1981. NTIS, PC A15/MF A01. File Number DE82010733. (CONF-811119—).

From NWTS program information meeting; Columbus, OH, USA (17 Nov 1981).

Detailed surface and subsurface investigations are continuing to determine the suitability of tuffs at Yucca Mountain for storage of high-level radioactive waste. The investigations involve not only identifying suitable rock-stratigraphic units, but also evaluating the potential for the total geohydrologic setting to provide multiple barriers to radionuclide transport. The work includes geologic, geophysical, and hydrologic investigations, including exploratory drilling.

36510 **(DP-MS—86-138) Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste.** Oblath, S.B. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 6p. (CONF-870306—59). NTIS, PC A02. File Number DE87011219.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Between 1953 and 1972, the Savannah River Plant (SRP) disposed of its solid, low-level radioactive waste in a 31 hectare shallow land burial site. A grid of 63 monitoring wells covering the site were used to sample for organic species in the groundwater which might enhance the mobility of radionuclides in the soil/water system. Total organic carbon (TOC) measurements were used as a screening method to select which wells should be used for oxalates, tri-n-butyl phosphate, and EDTA. More thorough analyses were performed using gas chromatography and mass spectrometry for a number of the wells. Over 60 compounds were identified. Spent solvents, scintillation wastes, and decomposing cellulosic wastes are believed to be the primary sources. None of the compounds were identified as strong complexing agents which would enhance migration. Preliminary experiments indicated that as much as 40% of the organic carbon may be humic material.

36511 **(DP-MS—87-1) Design of agitation systems in Bingham slurries by pilot simulation.** Nielsen, M.G. (Bechtel National, Inc., San Francisco, CA (USA)). 1987. Contract AC09-76SR00001. 11p. (CONF-870306—60). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011228.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A method was required to determine the optimum agitator speed needed to produce overall motion of the Defense Waste Processing Facility (DWPF) high-level waste slurries in remote process cell vessels. Project schedule and limited process space required an accurate determination of agitator horsepower and size without the benefit of full-scale testing. The small scale testing of unique clear rheologically similar fluid is described along with tests and scale-up procedures. 2 refs., 3 figs.

36512 **(DP-MS—87-10) Design of saltstone vaults.** Aiyar, G.S.; Hsiu, F.J. (Bechtel National, Inc., San Francisco, CA (USA)). 1987. Contract AC09-76SR00001. 13p. (CONF-870601—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011242.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Radioactive wastes from processed spent nuclear fuel at the Savannah River Plant, South Carolina, are stored in underground tanks. The wastes consist of sludge and supernate. Most of the radionuclides and some non-radioactive constituents are removed from the supernate. These, along with the sludge, are converted into a glass-crystallite matrix and cast into stainless steel canisters for future disposal in a geological repository. The decontaminated supernate, also called "salt solution," is mixed with cement, fly ash and a set-retarding agent and the resulting grout is transferred to reinforced concrete vaults where it sets into a monolith termed "saltstone." The vaults are then capped with concrete. A total of twenty-one vaults measuring approximately 600 ft x 100 ft x 27 ft high are planned for disposal of the existing supernate plus any additional supernate generated up to year 2000. The design of saltstone vaults meets two objectives - first, it satisfies the regulatory requirements for industrial solid waste disposal sites and facilities and secondly, it ensures a safe, efficient and economical facility to operate. Various alternatives for disposal of saltstone were studied before the present concept was selected. This paper summarizes the unique features and concepts utilized to meet the design and operational objectives of a solid waste disposal facility. To our knowledge, this is a first-of-a-kind facility of this type to be built in the USA.

36513 **(DP-MS—87-51) Recovery of transuranics from process residues.** Gray, J.H.; Gray, L.W. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 22p. (CONF-870661—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011252.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

Process residues are generated at both the Rocky Flats Plant (RFP) and the Savannah River Plant (SRP) during aqueous chemical and pyrochemical operations. Frequently, process operations will result in either impure products or produce residues sufficiently contaminated with transuranics to be nondiscardable as waste. Purification and recovery flowsheets for process residues have been developed to generate solutions compatible with subsequent Purex operations and either solid or liquid waste suitable for disposal. The "scrub alloy" and the "anode heel alloy" are examples of materials generated at RFP which have been processed at SRP using the developed recovery flowsheets. Examples of process residues being generated at SRP for which flowsheets are under development include LECO crucibles and alpha-contaminated hydraulic oil.

36514 **(DPST—85-953) Environmental information document: New hazardous and mixed waste storage/disposal facilities at the Savannah River Plant.** Cook, J.R.; Grant, M.W.; Towler, O.O. (Savannah River Lab., Aiken, SC (USA)). Apr 1987. Contract AC09-76SR00001. 463p. NTIS, PC A20. File Number DE87011239.

Site selection, alternative facilities and alternative operations are described for new hazardous and mixed waste storage/disposal facilities at the Savannah River Plant. Performance assessments and cost estimates for the alternatives are presented.

36515 **(EGG-M—29786) Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory.** Bower, J.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 4p. (CONF-870306—47). NTIS, PC A02. File Number DE87009398.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Since 1954, defense-generated transuranic (TRU) waste has been received at the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). A major objective of the Department of Energy (DOE) Nuclear Waste Management Programs is the proper management of the defense-generated TRU waste. The Stored Waste Examination Pilot Plant (SWEPP) is providing nondestructive examination and assay of retrievably stored contact handled TRU waste in order to certify it to the Waste Isolation Pilot Plant Waste Acceptance Crtieria (WIPP-WAC). SWEPP's capabilities for certifying contact handled waste containers include weighing, real-time radiographic examination, fissile material assay examination, container integrity examination, radiological surveys and labeling of waste containers. These processes involve not only instrument accuracy but also a wide range of technician interpretation from moderate on the assay to 100% on the radiograph. This, therefore, requires a variety of quality assurance techniques to ensure that the examinations and certifications are being performed correctly. The purpose of this paper is to discuss the methods utilized by SWEPP for checking on the examination process and to ensure that waste certifications are being properly performed. Included is the application of the quality assurance techniques to each examination system, the management of the data generated by the examination, and the verifications to ensure accurate certification. 1 ref.

36516 **(HEDL-TME—85-22) Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests.** Wilson, C.N. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1987. Contract AC06-76FF02170. 130p. NTIS, PC A07/MF A01; GPO Dep. File Number DE87011598.

PWR spent fuel rod segments from the H.B. Robinson Unit 2 and Turkey Point Unit 3 reactors were leach tested in Nevada Nuclear Waste Storage Investigations (NNWSI) reference J-13

water under ambient hot cell conditions. The test matrix included bare fuel plus the cladding, rod segments with artificially induced cladding defects, and undefected rod segments. Radionuclide release results are presented and discussed. The actinides Pu, Am, Cm and Np appear to have been released congruently as the $UO_2$ oxide fuel matrix dissolved. Preferential U release measured in certain tests may be related to dissolution of oxidized UO/sub 2+x/ from the fuel surface, and/or greater solubility (and mobility) of U relative to the other actinides within defected cladding specimens. Uranium solubility measured in the J-13 water was much greater then that measured in deionized water in previous tests. All of the principal fission products analyzed ($^{137}Cs$, $^{129}I$, $^{99}Tc$ and $^{90}Sr$) were released preferentially relative to the actinides. Preferential release of activation product $^{14}C$ was also measured, with a portion of the $^{14}C$ release appearing to originate from the cladding exterior surface. Much greater fractional fuel dissolution appeared to have occurred with bare fuel particles than from fuel contained in defected cladding. Actinide release from test specimens containing small (~200 μm) laser-drilled holes through the cladding was not significantly greater than from undefected specimens.

36517 **(K/SUB—85-22224/3) Monitor well installation at K-1407-B and K-1407-C surface impoundments at the Oak Ridge Gaseous Diffusion Plant.** (Geraghty and Miller, Inc., Oak Ridge, TN (USA)). Mar 1986. Contract AC05-84OT21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011802.

In October 1985, Geraghty and Miller, Inc. (G & M), was retained to design and install monitor wells in the uppermost aquifer, in the vicinity of two surface impoundments, in accordance with EPA regulations for interim status. This report describes the details of well construction and summarizes the geologic and hydrologic observations made during the drilling. Suggestions for sampling and analysis of water from the upper aquifer are included.

36518 **(K/SUB—85-22224/5) Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee.** Kuhlmeier, P.D.; Motley, C.A.; Archer, J.A. (Geraghty and Miller, Inc., Oak Ridge, TN (USA)). Jun 1987. Contract AC05-84OT21400. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011801.

This personnel Health and Safety Plan has been prepared for the purpose of providing for the safety of the personnel responsible for the installation of the ground-water monitor well network at the RCRA and CERCLA sites at the K-25 Plant, Oak Ridge, Tennessee.

36519 **(LA—10929-MS) Groundwater chemistry at Yucca Mountain, Nevada, and vicinity.** Kerrisk, J.F. (Los Alamos National Lab., NM (USA)). Feb 1987. Contract W-7405-ENG-36. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009465.

The chemistry of groundwater at Yucca Mountain and vicinity has been reviewed and compared with the chemistry of water from the Nevada Test Site and surrounding areas such as the Amargosa Desert and Oasis Valley. Sodium is the primary cation and carbonate is the primary anion in water from the saturated zone of the tuffaceous aquifer at Yucca Mountain. Other major cations present are calcium, potassium, and magnesium; other major anions are sulfate and chloride, with lesser quantities of fluoride and nitrate. Aqueous silica is also present. The primary purpose of this review was to survey water-composition data and look for relations among the compositional variables that could provide insight into the processes that control the composition and would ultimately affect radionuclide transport. The following conclusions were inferred from the review. Major cation concentrations are controlled by rock dissolution and mineral precipitation reactions as well as by cation exchange with existing minerals. Aqueous carbonate initially comes from atmospheric and soil-zone carbon dioxide, but there is evidence at Yucca Mountain that carbon dioxide in the gas phase of the unsaturated zone supplies additional carbonate to saturated-zone water in the tuffaceous aquifer as mineral dissolution and precipitation reactions raise the pH of the water. This combination is effectively mineral dissolution and precipitation in a system that is open with respect to carbon dioxide. A carbon model for this process is discussed.

36520 **(LA-UR—87-2252) Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$.** Norris, A.E.; Wolfsberg, K.; Gifford, S.K.; Bentley, H.W.; Elmore, D. (Los Alamos National Lab., NM (USA); Hydro Geo Chem., Inc., Tucson, AZ (USA); Rochester Univ., NY (USA). Nuclear Structure Research Lab.). Apr 1987. Contract W-7405-ENG-36. 7p. (CONF-8704112—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011330.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

Measurements of chloride and $^{36}Cl$ in soils from two locations near Yucca Mountain, Nevada, have been used to trace the infiltration of precipitation in this arid region. The results show that the $^{36}Cl$ fallout from nuclear weapons testing formed a well-defined peak at one location, with a maximum 0.5m below the surface. The structure of the $^{36}Cl$ bomb pulse at the other location was much more complex, and quantity of $^{36}Cl$ in the bomb pulse was $<1\%$ of the $6 \times 10^{12}$ atoms $^{36}Cl/m^2$ in the bomb pulse at the first location. The data indicate hydrologic activity subsequent to the $^{36}Cl$ bomb pulse fallout at one location, but none at the other location. 11 refs.

36521 **(NUREG/CR—4897) Low-level waste source term evaluation: Review of published modeling and experimental work, and presentation of low-level waste source term modeling framework and preliminary model development: Topical report.** Sullivan, T.; Kempf, C.R. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Feb 1987. Contract AC02-76CH00016. 104p. (BNL-NUREG—52066). NTIS, PC A06/MF A01 - GPO. File Number TI87011275.

Objective is development of a model to predict radionuclide release rates from a low-level waste disposal unit. The approach for model development has been based on a compartmentalized scheme focused on the four major processes of water flow, container degradation, waste leaching and waste radionuclide transport to the trench boundaries. This stage of the project is focused primarily on modeling release rates from shallow land burial as currently practiced. Research efforts to this point include characterization work (of burial trenches themselves, of soils and structural features, and of waste forms and containers), review of published modeling work, review of several waste package performance system models, and development of original container degradation and waste leaching models. Characterization of the wastes, containers, and of the site (trench soils and structure) has been based on the premise that NRC guidance has been put into effect. Quantitative prediction of the water flow in the trench is a major part of this program. The water flow equations are generally formulated to yield the hydraulic potential in the porous medium as a function of space and time. The solution of the water flow equations provides a method to obtain the average velocity with which the water moves at each spatial location in the disposal unit. This velocity is used in the contaminant transport equation. Inclusion of waste package container degradation and waste leaching leads to the radionuclide release amounts which must be coupled with the water flow and containment transport models to complete the scheme.

36522 **(ORNL/Sub—85-21674/1) Permeability of shale at elevated temperature and pressure: Test methodology and preliminary results.** Myer, L.R.; Christian, T.L. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011976.

A method of measuring the hydraulic conductivity of low permeability shale as a function of pressure and temperature has been developed and successfully demonstrated. Measurements have been performed on samples of Green River Formation up to a temperature of 140°C. For flow parallel to bedding hydraulic conductivities increased nonlinearly from $1.75 \times 10^{-16}$ m/s ($1.6 \times 10^{-23}$ m²) at 25°C, to $5.6 \times 10^{-15}$ m/s ($1.4 \times 10^{-22}$ m²) at 140°C. This increase in permeability with temperature may reflect an increase in microcrack porosity resulting from the heating.

**36523 (ORNL/TM—9681) Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Haase, C.S. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011971.

A comprehensive suite of geophysical logs was obtained from four deep monitoring boreholes at the New Hydrofracture Facility. The logging was an attempt to obtain stratigraphic, structural, and hydrologic information on the subsurface environment surrounding the hydrofracture facility. Logs obtained include caliper, gamma, neutron, density, single-point resistance, long- and short-normal resistivity, spontaneous potential, temperature, acoustic velocity, variable density, and borehole televiewer. Analysis and interpretation of the geophysical logs allowed the stratigraphic section at the facility to be determined and, by comparison with calibrated geophysical logs from borehole ORNL-Joy No. 2, allowed detailed inferences to be drawn about rock types and properties at the hydrofracture facility. Porosity values measured from the logs for Conasauga Group strata, as well as permeability values inferred from the logs, are low. Several intervals of apparently greater permeability, associated primarily with limestone-rich portions of the Maryville Limestone and sandstone-rich portions of the Rome Formation, were noted. Numerous fractures were identified by using several logs in combination. No one geophysical log was reliable for fracture identification although the acoustic-televiewer log appeared to have the greatest success. In addition to their characterization of subsurface conditions in the vicinity of the hydrofracture facility, the geophysical logs provided data on the extent of hydraulic fractures. Anomalies on single-point resistance logs that corresponded to prominent fractures identified on televiewer logs indicate intervals affected by hydraulic fractures associated with waste injection at the New Hydrofracture Facility. 14 refs.

**36524 (ORNL/TM—10289) A proposed classification system for high-level and other radioactive wastes.** Kocher, D.C.; Croff, A.G. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011957.

This report presents a proposal for quantitative and generally applicable risk-based definitions of high-level and other radioactive wastes. On the basis of historical descriptions and definitions of high-level waste (HLW), in which HLW has been defined in terms of its source as waste from reprocessing of spent nuclear fuel, we propose a more general definition based on the concept that HLW has two distinct attributes: HLW is (1) highly radioactive and (2) requires permanent isolation. This concept leads to a two-dimensional waste classification system in which one axis, related to "requires permanent isolation," is associated with long-term risks from waste disposal and the other axis, related to "highly radioactive," is associated with shorter-term risks due to high levels of decay heat and external radiation. We define wastes that require permanent isolation as wastes with concentrations of radionuclides exceeding the Class-C limits that are generally acceptable for near-surface land disposal, as specified in the US Nuclear Regulatory Commission's rulemaking 10 CFR Part 61 and its supporting documentation. HLW then is waste requiring permanent isolation that also is highly radioactive, and we define "highly radioactive" as a decay heat (power density) in the waste greater than 50 $W/m^3$ or an external radiation dose rate at a distance of 1 m from the waste greater than 100 rem/h (1 Sv/h), whichever is the more restrictive. This proposal also results in a definition of Transuranic (TRU) Waste and Equivalent as waste that requires permanent isolation but is not highly radioactive and a definition of low-level waste (LLW) as waste that does not require permanent isolation without regard to whether or not it is highly radioactive.

**36525 (ORNL/TM—10338) Considerations on a de minimis dose and disposal of exempt concentrations of radioactive wastes.** Kocher, D.C.; O'Donnell, F.R. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011954.

We propose as a generally applicable de minimis dose for members of the general public (1) a principal limit on annual committed effectie dose equivalent averaged over a lifetime of 0.01 mSv (1 mrem) and (2) a subsidiary limit on committed effective dose equivalent in any year of 0.05 mSv (5 mrem). Existing methodologies for using a de minimis dose are reviewed to derive exempt concentrations of radionuclides in solid wastes for purposes of disposal, and a methodology for application to disposal on the Oak Ridge Reservation is presented. Difficulties in application are discussed with reference to a proposal for an exemption level for uranium in solid wastes of 30 pCi/g. Finally, we discuss existing methods for measuring the uranium content in bulk solid wastes, because such measurements probably will be required in exempting uranium-bearing wastes for disposal.

**36526 (ORNL/TM—10474) A review of the organic geochemistry of shales.** Ho, P.C.; Meyer, R.E. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011889.

Shale formations have been suggested as a potential site for a high level nuclear waste repository. As a first step in the study of the possible interaction of nuclides with the organic components of the shales, literature on the identification of organic compounds from various shales of the continent of the United States has been reviewed. The Green River shale of the Cenozoic era is the most studied shale followed by the Pierre shale of the Mesozoic era and the Devonian black shale of the Paleozoic era. Organic compounds that have been identified from these shales are hydrocarbons, fatty acids, fatty alcohols, steranes, terpanes, carotenes, carbohydrates, amino acids, and porphyrins. However, these organic compounds constitute only a small fraction of the organics in shales and the majority of the organic compounds in shales are still unidentified.

**36527 (PNL—6148) Pilot-scale grout production test with a simulated low-level waste.** Fow, C.L.; Mitchell, D.H.; Treat, R.L.; Hymas, C.R. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011108.

Plans are underway at the Hanford Site near Richland, Washington, to convert the low-level fraction of radioactive liquid wastes to a grout form for permanent disposal. Grout is a mixture of liquid waste and grout formers, including portland cement, fly ash, and clays. In the plan, the grout slurry is pumped to subsurface concrete vaults on the Hanford Site, where the grout will solidify into large monoliths, thereby immobilizing the waste. A similar disposal concept is being planned at the Savannah River Laboratory site. The underground disposal of grout was conducted at Oak Ridge National Laboratory between 1966 and 1984. Design and construction of grout processing and disposal facilities are underway. The Transportable Grout Facility (TGF), operated by Rockwell Hanford Operations (Rockwell) for the Department of Energy (DOE), is scheduled to grout Phosphate/Sulfate N Reactor Operations Waste (PSW) in FY 1988. Phosphate/Sulfate Waste is a blend of two low-level waste streams generated at Hanford's N Reactor. Other wastes are scheduled to be grouted in subsequent years. Pacific Northwest Laboratory (PNL) is verifying that Hanford grouts can be safely and efficiently processed. To meet this objective, pilot-scale grout process equipment was installed. On July 29 and 30, 1986, PNL conducted a pilot-scale grout production test for Rockwell. During the test, 16,000 gallons of simulated nonradioactive PSW were mixed with grout formers to produce 22,000 gallons of PSW grout. The grout was pumped at a nominal rate of 15 gpm (about 25% of the nominal production rate planned for the TGF) to a lined and covered trench with a capacity of 30,000 gallons. Emplacement of grout in the trench will permit subsequent evaluation of homogeneity of grout in a large monolith. 12 refs., 34 figs., 5 tabs.

**36528 (PNL-SA—14426) Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste.** Pulsipher, B.A.; Kuhn, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 7p. (CONF-870306—58). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011138.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Current planning for liquid high-level nuclear wastes existing in the US includes processing in a liquid-fed ceramic melter to incorporate it into a high-quality glass, and placement in a deep geologic repository. The nuclear waste vitrification process requires assurance of a quality product with little or no final inspection. Statistical process control (SPC) is a quantitative approach to one quality assurance aspect of vitrified nuclear waste. This method for monitoring and controlling a process in the presence of uncertainties provides a statistical basis for decisions concerning product quality improvement. Statistical process control is shown to be a feasible and beneficial tool to help the waste glass producers demonstrate that the vitrification process can be controlled sufficiently to produce an acceptable product. This quantitative aspect of quality assurance could be an effective means of establishing confidence in the claims to a quality product. 2 refs., 4 figs.

36529 **(PNL-SA—14624) Geologic software for nuclear waste repository studies: A quality assurance program.** Figuli, S.; English, S.L. (Kent State Univ., OH (USA); Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 6p. (CONF-8705153—1). NTIS, PC A02/MF 01; GPO Dep. File Number DE87011995.

From Geological Society of American Cordilleran section meeting; Hilo, HI, USA (20 May 1987).

This paper discusses a Quality Assurance (QA) program that Kent State University (KSU) has implemented for the development of geologic software. The software being developed at KSU will be used in the site characterization of nuclear waste repositories and must meet the requirements of federal regulations. This QA program addresses the development of models that will be used in the evaluation of the long-term climatic stability of three sites in the western US.

36530 **(PNL-SA—14767) Spent fuel performance in geologic repository environments.** Bradley, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 46p. (CONF-8704154—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011155.

From 2. research coordination meeting of the performance of solidified high-level waste forms and engineering barriersunder repository conditions; Sydney, Australia (6 Apr 1987).

The performance assessment of the waste package is a current area of study in the United States program to develop a geologic repository for nuclear waste isolation. The waste package is presently envisioned as the waste form and its surrounding containers and possibly a packing material composed of crushed host rock or mixtures of that rock with clays. This waste package is tied to performance objectives set forth in regulatory criteria. It is the goal of the Civilian Radioactive Waste Management Program (OCRWM) to obtain the necessary information on the waste package, in several geologic environments, to show that the waste package provides reasonable assurance of meeting established performance criteria. This paper discusses the United States program directed toward managing high-level radioactive waste, with emphasis on the current effort to define the behavior of irradiated spent fuel in repository environments. Spent fuel is of particular interest since it is expected to be the primary nuclear waste form disposed in a geologic repository. Current studies are directed toward understanding the rate and nature (such as valence state, colloid form if any, solid phase controlling solubility) of radionuclide release from the spent fuel. Due to the strong interactive effect of radiation, thermal fields, and waste package components on this release, current spent fuel studies are being conducted primarily in the presence of waste package components over a wide range of potential environments. 52 refs.

36531 **(PNL/SRP—6253) Data report on static leach tests with Savannah River Laboratory defense waste glass in PBB1 brine at 90°C: Salt Repository Project.** McGrail, B.P.; Eliason, V.L. (Pacific Northwest Lab., Richland, WA (USA). Salt Repository Project). Jun 1987. Contract AC06-76RL01830. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011272.

The dissolution of glass waste forms in aqueous media is the only means by which encapsulated radionuclides become mobile and available for transport to the environment, discounting the unlikely potential for release by solid-state diffusion. Because groundwater movement presumably involves the slow ingress and egress of brine around the waste package, static leach tests provide a realistic simulation of expected hydrodynamic conditions in the engineered barrier system. Data from static leach tests are used to develop an integrated radionuclide release model. The integrated model consists of several components also determined from these tests, including saturation concentrations for low-solubility radionuclides, a source term for colloids and pseudocolloids, glass dissolution kinetics, and rate-controlling mechanisms of glass dissolution. The tests described in this data report are outlined in the FY 1986 Technical Program Plan, WBS Element 0201 - Static Testing, for the SRP Defense Glass Studies Program at Pacific Northwest Laboratory.

36532 **(RHO-RE-SA—182) Pretreatment of Hanford PUREX Plant first-cycle waste.** Gibson, M.W.; Gerboth, D.M.; Peters, B.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1987. Contract AC06-77RL01030. 19p. (CONF-870306—56). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010688.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A process has been developed to pretreat neutralized, first-cycle high-level waste from the fuels reprocessing facility at the Hanford Site. The process separates solids from the supernate liquid, which contains soluble salts. The solids, including most of the fission products and transuranic elements, may then be vitrified for disposal, while the low-level supernate stream may be processed into a less expensive grout waste form. The process also includes ion exchange treatment of the separated supernate stream to remove radiocesium. A flow sheet based on these operations was completed to support a planned demonstration of the process in the Hanford Site B Plant canyon facility. 5 refs., 2 figs., 5 tabs.

36533 **(SAND—83-0768) Analytic models of nuclide transport in saturated geologic media.** Klett, R.D.; Treadway, A.H.; Hertel, E.S. Jr.; Garner, J.W. (Sandia National Labs., Albuquerque, NM (USA); G2vanTel Ltd., Albuquerque, NM (USA); Applied Physics, Inc., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 325p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87010623.

This report describes the TRION Series of computer programs which consists of two major programs, the core program TRION and the performance assessment program SEDTRN, and several special application programs. The results presented in the Derivations and Solutions to the Diffusion Equations section are used in TRION and SEDTRAN and are the basis for some of the special application programs. The solutions are for two-dimensional axisymmetric diffusion with point and line sources, instantaneous and pulse release, sorbtion, a zero-concentration upper sediment boundary simulating the ocean, and either an impermeable lower boundary or an infinitely thick sediment. An array of canisters can be simulated with an impermeable cylindrical boundary around the source.

36534 **(SAND—84-7208) Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel.** St. John, C.M. (Agbabian Associates, El Segundo, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012345.

This report summarizes the results of a series of analyses of excavations in the vicinity of waste emplacement panels. Specific consideration is given to the access drifts running between adjacent emplacement panels, the drift intersection at the entrance to the emplacement panels, and the waste emplacement excavations. Both horizontal and vertical emplacement models are considered, but greater emphasis is placed on the former. Three numerical modeling procedures were used in this study: a finite-element model was used for three-dimensional stress analysis of the tunnel intersection, a model based on the closed-form solution for point heat sources

was used to predict temperatures and stresses in the vicinity of the emplacement panel, and simple two-dimensional boundary-element models were used to predict temperatures and stresses around excavations of various shapes. The results of two-dimensional stress analyses were postprocessed to determine the extent to which the strength of a rock mass, containing a set of vertical joints, was exceeded. The results presented in this report do not indicate that there will be any particular stability problems at the tunnel intersection investigated. Further, the effect of waste emplacement within the adjacent panels is to decrease the vertical rock stresses and increase the horizontal rock stresses at the intersection. These stress changes will tend to enhance the stability of larger-span excavations, including the tunnel intersection and the alcoves necessary for horizontal emplacement of waste canisters. The relatively high horizontal stresses experienced by the access were identified as a potential concern. However, evaluation of recent data on the thermomechanical properties of the rock mass modeled here has indicated that the stress changes will not be as severe as stated herein.

36535 **(SAND—85-7208) Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand.** Pfeifle, T.W. (RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1987. Contract AC04-76DP00789. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012509.

Thermomechanical properties of intact rock salt and the waste package materials have appeared in the literature. Only limited data is available, however, for the two backfill materials of interest in the analyses, crushed salt and 70/30 (by weight) bentonite/sand. A unique property of bentonite-based materials is the propensity for clay particles to swell as a result of water sorption. If volume expansion is prevented or partially restricted, pressures are built up within the bentonite materials. Therefore, the primary objective of this study is to supply appropriate data (not available in the literature) in support of the aforementioned detailed thermomechanical stress analyses. The study consists of laboratory tests performed on samples of crushed salt and 70/30 bentonite/sand. The remainder of this report is organized into five chapters and four appendixes. Chapter 2 describes the specimens tested in this study. Chapter 3 describes the testing machines and test procedures used. Chapter 4 gives the results of the tests on crushed salt and 70/30 bentonite/sand. Chapter 5 gives conclusions of the test program and is followed by a list of cited references. Four appendixes conclude the report. The first and second give stress-strain curves for the unconfined compression tests on crushed salt and 70/30 bentonite/sand, respectively; the third gives details of the algorithm used to compute volumetric strains during hydrostatic compression tests which accounts for vessel volume change; while the final appendix gives mean stress-volumetric strain curves for the hydrostatic compression tests. 16 refs., 18 figs., 10 tabs.

36536 **(SAND—86-0929) Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984.** Marietta, M.G.; Simmons, W.F. (Technadyne Engineering Consultants, Inc., Woods Hole, MA (USA); Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87012343.

The Subseabed Disposal Project (SDP), managed at and in part conducted by Sandia National Laboratories (SNL) for the US Department of Energy, is designed to evaluate the scientific, technical, environmental and economic feasibility of depositing high-level nuclear wastes (HLW) within the sediments at the bottom of the deep ocean. The work is in part to assist US planners in devising and assessing global disposal options, and in part to assist other nations in assessing the feasibility and consequences of oceanic nuclear waste disposal. At the schematic level, there appear to be many advantages to ocean disposal. First, the sites under consideration are some of the most stable geological formations on the face of the earth, far from the active edges of tectonic plates and generally composed of thick sedimentary layers many millions of years old and many thousands of square kilometers in area. They are generally near the centers of the main oceanic circulation gyres and are therefore remote from the principal oceanic current systems. The deep sediments can be penetrated to 30 m or more meters at burial, and form thereafter an effective first barrier. Most of the radioactive nuclides which would eventually leak from the burial containers are permanently trapped in the sediments by chemical adsorption. As the deep sediments are anomalously poor in biological and mineral resources, radioactive decomposition of the sorbed nuclides promises to be relatively innocuous. Low deep-water temperatures (~1°C) and high pressures (~500 atms.) provide an excellent environment for heat dissipation. Lastly, the sites are geographically remote and are rarely visited by seafarers of any kind. 55 refs.

36537 **(SAND—86-0977) Analysis of a proposed NNWSI exploratory shaft slot test for tuff response.** Conley, C.H. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009351.

Yucca Mountain in Nevada has been chosen as a potential site for a commercial nuclear waste repository. Sandia National Laboratories is participating in a program to investigate the feasibility of the Yucca Mountain site. One aspect of that study will be an exploratory shaft in Yucca Mountain in which several experiments will be fielded to gain information to assist in the feasibility assessment. This report describes a set of analyses of one of the experiments that has been proposed for the exploratory shaft. The experiment involves cutting a slot in the rock, in this case a densely welded tuff, and pressurizing the slot via a flatjack inserted in the slot. It is anticipated that information on the in situ stress state and strength of the tuff and information useful for verification of analytical techniques will be obtained in the experiment. It is also possible that a relationship between force and deformation for the tuff can be determined. These analyses demonstrated that the experiment could be performed as described in the test plan. The compliant-joint modeling technique that was developed for the project was shown to produce reasonable results in this type of analysis. Several issues of geomechanical modeling were brought out and addressed through the course of the analyses. As a result of the analyses, when more definitive properties for the tuff and the exact geometry of the experiment are known, it will be relatively easy to develop pretest predictions for the behavior of the tuff in the pressurized slot experiment. These predictions can then be compared to the actual behavior for verification of the analysis technique. 13 refs., 37 figs.

36538 **(SAND—86-7133) Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff.** Arulmoli, K.; St. John, C.M. (Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA)). Mar 1987. Contract AC04-76DP00789. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010529.

In support of the design of a nuclear waste repository in tuff, two dimensional thermal and thermal-mechanical analyses of horizontal emplacement boreholes were performed using finite-element and boundary-element codes. In the finite-element analyses five different equivalent continuum models of a tuff rock mass were used to investigate the state of deformation and stress around the borehole for times up to 300 years following waste emplacement. These models were an isotropic linear elastic model, an ubiquitous joint model with single and orthogonal joints, an a compliant joint model also with single and orthogonal joints. The case of boreholes intersected by discrete fractures was analyzed using boundary-element models. The results of analyses using the various models of the borehole were consistent and indicated stable conditions even when low estimates of the strength of the joints within the tuff rock mass were assumed. 25 refs.

36539 **(SAND—87-0115) Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project.** Nimick, F.B. (comp.). (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011586.

This document is composed of two technical memorandums containing information that has been referenced in the Site Characterization Plan for the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. The NNWSI Project is characterizing the Yucca Mountain site on the Nevada Test Site (NTS) to study the feasibility of constructing a high-level waste repository in the To-

popah Spring Member of the Paintbrush Tuff. The information pertains to the following subject areas: (1) the potential for thermal degradation of the Topopah Spring tuff; and (2) updated data analysis for Goodman Jack tests performed in G-tunnel on the NTS.

36540 **(SAND—87-0176) Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986.** Stormont, J.C.; Peterson, E.W.; Lagus, P.L. (Sandia National Labs., Albuquerque, NM (USA); S-Cubed, San Diego, CA (USA)). May 1987. Contract AC04-76DP00789. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011611.

Numerous gas flow measurements have been made at the Waste Isolation Pilot Plant (WIPP) Facility horizon from 1984 through 1986. Almost all tests have been constant-pressure or pressure-decay tests from single boreholes drilled in the underground excavations. Results indicate that beyond about 2 m from an excavation, both halite and interbeds (anhydrite and clay layers) allowed very low gas flows, and calculated permeabilities are below 1 microdarcy. In regions within 2 m of an excavation very high flow rates were measured in the interbeds immediately above and below an excavation when the test hole was drilled from near the center of the excavation. Further, measured flow rates increase with the width of the excavation. The halite also permits substantially greater gas flow within about 1 m of the excavations. Limited tracer measurements reveal that flow paths in both the halite and interbeds in the near field region are significantly larger than those in the presumed undisturbed condition. The gas flow measurements are consistent with the development of a (perhaps partially-saturated) dilatant zone (increased porosity) around the excavations. Considerable uncertainty is associated with permeabilities calculated from these flow measurements, due to unknowns of rock saturation, entry pressure effects, flow homogeneity, etc.

36541 **Statistical structure and filter characteristics of tritium fluctuations in fractured basalt.** Duffy, C.J.; Harrison, J. (Utah State Univ., Logan). *Water Resources Research;* **23**: No. 5, 894-902(May 1987).

The statistical structure and spectral-covariance characteristics of tritium fluctuations are examined from injection of low-level radioactive waste in a fractured basalt aquifer. The tritium fluctuations are the result of a time-varying injection well concentration. The integral scale of the fluctuations increases with distance from the source and the observation well spectra are characteristic of a dispersive-type filter. On the basis of these qualitative attenuation characteristics, a theoretical filter is constructed and transport parameters are estimated. The analysis indicates that environmental tracers may provide a useful extension to controlled tests over large length scales (> 100 ml). Although current research has concentrated on the importance of intrinsic variability such as porous media heterogeneities, the present study addresses the control exerted by extrinsic variability as exhibited by source strength fluctuations.

36542 **Waste disposal package.** Smith, M.J. (to Dept. of Energy, Washington, DC USA). British Patent 2,176,925/A/. 7 Jan 1987. Priority date 19 Jun 1985, United States of America (USA), 5p. Patent Office, 25 Southampton Buildings, London, WC2A 1AY.

US priority 746597.

A waste disposal package including an inner or primary canister for containing hazardous and/or radioactive wastes. The primary canister is encapsulated by an outer or secondary barrier forming a porous mechanical barrier to control ingress of water to the canister and the release rate of wastes upon breach of the canister. The barrier is preferably a ceramic material and is formed of a plurality of separate assemblable sections.

36543 **Status of U.S. nuclear waste disposal programs.** Eastering, J.B. (Div. of Policy and Institutional Planning, Office of Civilian Radioactive Waste Management, U.S. Dept. of Energy, Washington, DC). pp 27-34 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Since the days of the Manhattan Project in the early 1940's, the United States has recognized the need for a system of effective nuclear waste management. The evolution of that system has been directed by a series of legislative actions to determine responsibilities and develop procedures. Under these laws, the U.S. Department of Energy (DOE), as the lead agency, is required to plan and implement the programs that will ensure safe and efficient management of nuclear wastes from both civilian and defense activities. This overview paper describes the organization of these programs.

36544 **The socioeconomic impacts of high-level nuclear waste facility siting.** Murdock, S.H.; Leistritz, F.L.; Hamm, R.R. (Texas A and M Univ., College Station, TX). pp 99-106 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

High-level nuclear waste repositories will be located in sparsely settled rural areas in the U.S. These projects will significantly effect the economic, demographic, public service, fiscal, and social (the socioeconomic) dimensions of those rural areas. This paper examines some of the potential socioeconomic impacts and the characteristics of mitigation programs necessary, if these impacts are to be addressed. Both standard impacts, those resulting from the fact that--like many other large-scale developments--repositories will involve a substantial number of new workers and residents (relative to the size of existing communities) and special impacts, those resulting from the fact that repositories store radioactive materials, are examined.

36545 **The need for public education: Nuclear waste disposal programs.** Willis, Y.A. (Program Development, Westinghouse Electric Corp., Waste Technology Services Div., Madison, PA). pp 93-98 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The nuclear industry has made great technical strides in the quest for safe and efficient management and disposal of nuclear wastes. Public acceptance and cooperation, however, lag far behind. An extensive in-depth public information campaign must be instituted if the public is to deal with nuclear waste issues intelligently and reasonably rather than emotionally. Westinghouse has developed the Nuclear Waste Management Outreach Program, an objective seminar series, to make the necessary information both available and accessible. The program was initially designed as a broad-scoped nuclear waste management overview to give participants comprehensive information on all aspects of nuclear waste.

36546 **The remote installation of a new riser on an existing high level waste (HLW) tank.** Scott, D.W.; Moore, T.L.; Schiffhauer, M.A. (Rockwell Hanford Operations, P.O. Box 800, Richland, WA 99352). pp 529-536 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

On October 1, 1980, the U.S. Congress passed the WVDP Act, directing the U.S. Department of Energy (DOE) to undertake a high level radioactive waste management demonstration project at the West Valley Site. Under the Act, the DOE is responsible for solidifying the high level waste in a form suitable for transportation to a federal repository for ultimate disposal. West Valley Nuclear Services Company, Inc. (WVNS), a wholly-owned subsidiary of Westinghouse Electric Corporation, is implementing the Project for the DOE. The largest volume of high level waste (HLW) stored underground at West Valley is in Tank 8D-2, containing approximately 2,250 m/sup 3/ of supernatant and 170 m/sup 3/ of sludge. An identical spare tank (8D-1) is approximately one-third full of contaminated condensate. The supernatant phase of the waste will be decontaminated to a level which will permit it to be solidified in concrete and disposed of as low level waste. The radioactive contaminants removed from the supernatant will be combined with the

balance of the high level waste, delivered to a slurry fed ceramic melter (SFCM), and solidified into borosilicate glass. The waste must first be removed from these tanks before it can be vitrified. This paper addresses the task of gaining access to the tank interiors for the removal process. The complex internal geometry of the tank requires a special array of sluicing pumps to homogenize the supernatant and sludge for the removal process. The one existing riser large enough to install a slurry pump is insufficient to provide adequate removal of the waste.

## 0530 Environmental Aspects

*REFER ALSO TO CITATION(S) 36480, 36496, 36500, 36518, 36521, 36531, 36552, 36799, 37818, 37819, 37826, 37850, 37853, 37854*

36547 **(DOE/EA—0254) Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jun 1987. 592p. NTIS, PC A25/MF A01. File Number DE87011700.

The US Department of Energy (DOE) has prepared an environmental assessment (DOE/EA-0254) on the proposed remedial action at the inactive uranium milling site near Riverton, Wyoming. Based on the analyses in the EA, the DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321, et seq.). Therefore, the preparation of an environmental impact statement (EIS) is not required.

36548 **(DOE/EIS—0132-D-Vol.1) Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado: Volume 1, Text.** (USDOE Albuquerque Operations Office, NM). May 1987. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87010643.

This statement evaluates and compares the environmental impacts associated with the remedial actions for the residual radioactive materials remaining at the inactive uranium processing sites at Rifle, Garfield County, Colorado. The Rifle tailings sites consist of the separate Old and New Rifle tailings sites. Together, the Old and New Rifle sites cover 164 acres of private land and contain approximately 3,510,000 cubic yards of tailings and associated contaminated soils. The tailings were produced by the Union Carbide Corporation when it processed vanadium and uranium ores from 1924 to 1932 and from 1942 to 1973. The US Atomic Energy Commission purchased uranium from the sites from 1949 to 1971; additional uranium and all of the vanadium were sold to commercial buyers. This statement evaluates four alternatives for stabilization and disposal of the tailings and other contaminated material.

36549 **(DPST—85-856) Environmental information document: Y Area.** Cook, J.R.; Grant, M.W. (Savannah River Lab., Aiken, SC (USA)). 16 Dec 1986. Contract AC09-76SR00001. 432p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE87011240.

Site selection, facility descriptions, and alternative operations are described for disposal/storage of concentrated waste streams resulting from waste treatment facilities at the Savannah River Plant. Performance assessments and cost estimates for these alternatives are presented. The new disposal site for this waste will be designated Y Area.

36550 **(MHSMP—87-18) Environmental monitoring report for Pantex Plant covering 1986.** Laseter, W.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Apr 1987. Contract AC04-76DP00487. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012069.

This report summarizes the environmental monitoring program at Pantex Plant for 1986. It has been prepared in accordance with the US Department of Energy Order 5484.1. This report presents monitoring data for both radioactive and nonradioactive species in the local environment. Plant activities involve the handling of significant quantities of uranium, plutonium and tritium in the form of completed parts received from other DOE facilities, resulting in a very low potential for release of these radionuclides to the atmosphere. In 1986 only small releases of depleted uranium (depleted in the isotope U-235) and tritium occurred which could have affected the local environment. Monitoring data indicate that concentrations of these nuclides in the environment are below established criteria for air and water and therefore should not present a health hazard either to employees or to the public.

36551 **(PB—87-173167/XAB) Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report.** Pritchard, P.C.H.; Bloodwell, J.M. (Florida Audubon Society, Maitland (USA)). Nov 1986. 75p. NTIS, PC A04/MF A01.

The phosphate-rich mineral deposits of central Florida tend to exhibit background radiation levels that are elevated due to the uranium and its decay products found in association with the ore. The report documents radioactivity levels in two groups of animals that had heretofore not been examined by other investigators – aquatic reptiles (American alligators, softshell turtles, and Florida cooter turtles) and terrestrial mammals (armadillos), based on the criterion that these species have significant proportions of their mass comprised of bony tissue likely to show elevated concentrations of radium. The alligator bones contained only low concentrations of radium, and there were no significant differences between alligators collected from mined, mineralized-unmined, or unmineralized land. Whether the levels of radium in the bones of the turtles represents a hazard to the health of these long-lived animals or to humans who may consume their flesh is unclear.

## 0540 Health And Safety

*REFER ALSO TO CITATION(S) 36549, 36892, 37933*

36552 **(DOE/EA—0322) Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Jun 1987. 344p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87011997.

This document assesses and compares the environmental impacts of various alternatives for remedial action at the Ambrosia Lake uranium mill tailings site located near Ambrosia Lake, New Mexico. The designated site covers 196 acres and contains 111 acres of tailings and some of the original mill structures. The Uranium Mill Tailings Radiation Control Act (UMTRCA), Public Law 95-604, authorizes the US Department of Energy to clean up the site to reduce the potential health impacts associated with the residual radioactive materials remaining at the site and at associated properties off the site. The US Environmental Protection Agency promulgated standards for th remedial action (40 CFR Part 192). Remedial action must be performed in accordance with these standards and with the concurrence of the Nuclear Regulatory Commission. The proposed action is to stabilize the tailings at their present location by consolidating the tailings and associated contaminated materials into a recontoured pile. A radon barrier would be constructed over the pile and various erosion protection measures would be taken to assure the long-term stability of the pile. Another alternative which would involve moving the tailings to a new location is also assessed in this document. This alternative would generally involve greater short-term impacts and costs but would result in stabilization of the tailings at an undeveloped location. The no action alternative is also assessed in this document.

36553 **(DOE/NE/44139—20) Technical and administrative approach for the West Valley Demonstration Project Safety Program.** Newsom, P.C.; Roberts, C.J.; Yuchien Yuan, Marchetti, S. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Jun 1987. Contract AC07-81NE44139. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011799.

The principal objective of the West Valley Demonstration Project (WVDP) is to vitrify the 2.2 million liters of high-level radioactive waste (HLW) stored at the Western New York Nuclear Service Center (WNYNSC). This simple statement of purpose,

however, does not convey a sense of the complexity of the undertaking. The vitrification task is not only complex in and of itself, but requires a myriad of other activities to be accomplished on an intricate and fast paced schedule in order to support it. The West Valley Demonstration Project Act (P.L 96-368), U.S. Department of Energy Order DOE-5481.1A, Idaho Operations Office Order ID-5481.1 and standard nuclear industry practice all require that proposed systems and operations involving hazards not routinely encountered by the general public be analyzed to identify potential hazards and consequences, and to assure that reasonable measures are taken to eliminate, control, or mitigate these potential consequences. Virtually every substantive aspect of the WVDP involves hazards beyond those routinely encountered and accepted by the general public. In order to assure the safety of the public and the workers at the WVDP, a system of hazard identification, categorization, analysis and review has been established. In parallel with this system, a procedure for developing the minimum design specifications and quality assurance requirements has been developed for Project systems, components, and structures which play a role in the safety of a specific major facility or the overall Project. 29 refs., 3 figs., 6 tabs.

**36554 (NUREG/CR—4726) Evaluation of protective action risks.** Witzig, W.F.; Shillenn, J.K. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Jun 1987. 210p. NTIS, PC A10/MF A01 - GPO. File Number TI87900879.

The purpose of this study is to determine how the risks of the protective action of evacuation compare with the radiological risks from a radiation release if no protective actions are taken. Evacuation risks of death and injury have been determined by identifying from newspapers and other sources 902 possible evacuation events which occurred in the US during the period January 1, 1973 through April 30, 1986. A survey form was developed to determine evacuation risks and other information relating to the evacuation events and sent to local emergency management personnel located in the vicinity of 783 events. There were 310 completed surveys received and the data summarized. This study found that the key factors for a successful evacuation included an emergency plan, good communications and coordination, practice drills, and defined authority. Few successful evacuations used the emergency broadcasting system or warning sirens to communicate the need to evacuate. Reports of panic and traffic jams during an evacuation were very few. Traffic jams occurring during reentry were more likely than during the evacuation exodus. A summary of potential societal consequences of evacuation is included in this study. 5 refs., 9 figs., 20 tabs.

**36555 (PNL-SA—14225) Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring.** Kenoyer, J.L.; Vallario, E.J.; Murphy, B.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 360p. (CONF-8510235—). NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87011680.

From Workplace aerosol monitoring workshop; Napa, CA, USA (28 Oct 1985).

The workshop on Workshop Aerosol Monitoring was held October 28-30, 1985 in Napa, California and was sponsored by the US Department of Energy, Radiological Controls Division. This workshop brought together participants from the United States, England, France, and West Germany who represented government, research, and industry. The participants discussed the types of air sampling and air monitoring instrumentation that are currently being developed, the problems that need to be addressed in order to obtain "representative" samples, and the need for a lower minimum detectable activity to protect the worker from inhalation of radionuclides in a timely manner. This proceedings includes papers and speeches that were presented at the workshop, plus edited transcripts of panel and open discussions, and question and answer sessions.

**36556 (SI—85-4-23-Del.Ver.) [Plutonium accumulation in tank (DPSPU-85-272-35)].** (Savannah River Lab., Aiken, SC (USA)). 4 Apr 1985. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010194.

Gradual accumulations of plutonium in the tank were not accurately detected and/or fully removed by routine flushing. Suggested modifications in procedures for preventing this are given. (DLC)

## 0550 Safeguards, Inspection, And Accountability

*REFER ALSO TO CITATION(S) 36976*

**36557 (BNL—39822) A safeguards risk approach to inspection scheduling.** Indusi, J.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870713—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010763.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Scheduling facilities for safeguards and security inspections may be based on a relative safeguards risk ranking of the facilities under consideration. Safeguards risk is defined as a combination of the potential threat, facility vulnerability to various malevolent events, and the consequences that may occur if a malevolent event is successfully carried out. Quantification of the vulnerability (on a relative scale) and consequences may be possible, however the probability of a particular threat is impossible to estimate. The problem has been researched and an approach has been formulated which yields a relative safeguards risk ranking for a given group of facilities, malevolent events and potential threat groups. This approach may be useful in helping to direct inspection activities to high risk operations instead of being driven by a single element such as vulnerabilities or consequences.

**36558 (DOE/DP—0043) Department of Energy Emergency Management Functional Requirements Study.** (USDOE Assistant Secretary for Defense Programs, Washington, DC). May 1987. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011615.

This Study, the Emergency Management Functional Requirements Study (EMFRS), identifies the physical environment, information resources, and equipment required in the DOE Headquarters Emergency Operations Center (EOC) to support the DOE staff in managing an emergency. It is the first step toward converting the present Forrestal EOC into a practical facility that will function well in each of the highly diverse types of emergencies in which the Department could be involved. 2 figs.

**36559 (DP-MS—86-8) A nondestructive assay standards program at the Savannah River Plant.** Studley, R.V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 13p. (CONF-870713—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011253.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

To minimize accountability inventory differences, high accuracy standards are needed to complement recently developed high precision NDA instruments. A program to acquire specific material standards having the highest achievable accuracy was developed and successfully completed. The goal for this program was to define performance of NDA systems to at least 0.1% +- 1$\sigma$ accuracy. Among sixteen standards that were evaluated, relative standard deviations from traceable values were better than 0.042%. This was a significant achievement by the four participating analytical laboratories, particularly considering dissolution difficulties of some of the materials. Value of this level of accuracy is significant since some NDA equipment installed in the process has achieved precision better than +-0.1% +-$\sigma$ of full range. These instruments with forecast good long-term stability and the high accuracy standards should significantly reduce IDs that would have resulted if current measurement techniques had been used. 12 refs., 3 figs., 2 tabs.

**36560 (LA-UR—87-1952) The R and D/operational MC and A [materials control and accounting] interface.** Shipley, J.P. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 7p. (CONF-870713—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011783.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Improvements in our ability to do materials control and accounting (MC and A) have been steady since the beginning of the nuclear age and the appearance of processes and facilities for handling nuclear materials. The motivation for these improvements has not been just safeguards: the desire for better process control also has played a major role, and the emergence of technology focused on the problems of MC and A has made it possible to pursue such improvements. However, it is a continuing challenge to match the needs of the operational MC and A elements with the capabilities and resources of the R and D community. In the last couple of years this challenge has been addressed very visibly by the DOE's Project Cerberus R and D Committee, which has devised a procedure to encourage closer interactions between the operations and R and D elements. In the particular case of Los Alamos, we have recently concluded the efforts of the Nuclear Materials Management and Safeguards Task Force, which made strong recommendations about the need for close internal cooperation. The issues associated with these activities and the specific means for addressing them, will be of surpassing interest for the future of safeguards.

36561 **(LA-UR—87-2116) New portable hand-held radiation instruments for measurements and monitoring.** Fehlau, P.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870713—17). NTIS, PC A02. File Number DE87011752.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Hand-held radiation monitors are often used to search pedestrians and motor vehicles for special nuclear material (SNM) as part of a physical protection plan for nuclear materials. Recently, the Los Alamos Advanced Nuclear Technology group has commercialized an improved hand-held monitor that can be used for both physical-protection monitoring and verification measurements in nuclear material control and waste management. The new monitoring instruments are smaller and lighter; operate much longer on a battery charge; are available with NaI(Tl) or neutron and gamma-ray sensitive plastic scintillation detectors; and are less expensive than other comparable instruments. They also have a second operating mode for making precise measurements over counting times as long as 99 s. This mode permits making basic verification measurements that may be needed before transporting nuclear material or waste outside protected areas. Improved verification measurements can be made with a second new hand-held instrument that has a stabilized detector and three separate gamma-ray energy windows to obtain spectral information for SNM quantity, enrichment, or material-type verification.

36562 **(LA-UR—87-2117) A neutron portal monitor for vehicles.** Coop, K.L.; Fehlau, P.E.; Atwater, H.F. (Los Alamos National Lab., NM (USA)). 12 Jul 1987. Contract W-7405-ENG-36. 8p. (CONF-870713—10). NTIS, PC A02. File Number DE87011751.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

We have designed and built a portal vehicle monitoring systems for detecting neutron-emitting special nuclear material (SNM) such as plutonium. Monte Carlo calculations were used to optimize the design of the 15-cm-deep x 122-cm-high x 244-cm-long detector chambers, which utilize $^3$He proportional counters inside a hollow polyethylene box. Results for a variety of parametric studies, including polyethylene thickness and detector number, are described. Our experimental measurements are in good agreement with the computer calculations. The monitor's decision logic uses the Sequential Probability Ratio Test (SPRT) on Poisson distributed counting data, which is superior to other statistical tests in many applications. We performed computer simulations of the SPRT logic to determine expected false-positive decision rates. A controller unit of our design that uses this SPRT was built commercially. The cost of the complete monitoring system is similar to that of vehicle portal monitors that detect gamma rays. This new neutron monitor can serve as an addition to standard gamma-ray vehicle portals or as a stand-alone portal monitor in particular safeguards monitoring situations. The monitor is being tested at Los Alamos and is scheduled for in-plant evaluation of another DOE facility in 1987. 7 refs.

36563 **(MLM—3441) A measurement control study for tritium gas.** Lindsay, C.N.; Sprague, R.E.; Brandenburg, J.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 8 Jul 1987. Contract AC04-76DP00053. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012325.

To implement a program for measurement control of the site's tritium inventory, a study comparing pressure-volume-temperature-mass spectrometry (PVT/MS) and calorimetry methods of measuring tritium was conducted at Mound. Fifty bottles of tritium gas were measured by both PVT/MS and calorimetry methods, and the uncertainties of the two methods were calculated using propagation of error. It was found that PVT/MS measurements plus their uncertainties completely overlapped the calorimeter measurements plus their uncertainties. A new method for determining reasonable control limits for new PVT/MS systems was suggested based on the results of this study. This method was applied to the results of the study to prove its effectiveness. The new method will be easier to use than the previous "theoretical" method, while giving satisfactory results.

36564 **(SAND—86-2986C) Verification of a modular Safeguards Control and Communication System.** Ortiz, S.; Roybal, J.A.; Quintana, G.R.; Williams, J.S. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 6p. (CONF-870713—13). NTIS, PC A02. File Number DE87011859.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A Safeguards Control and Communication System (SCCS) has been developed for a facility based on existing modular SCCS software for another facility. The majority of FORTRAN 77 software modules were directly carried over from one SCCS to the other with only minor modifications for site-specific considerations. Therefore, savings in time and money for design, development, fabrication, and documentation were realized. Two significant hardware changes were made in the SCCS which accounted for most of the software development. The Alarm Multiplexer Communication System (AMCS) was used instead of the Loop Multiplexer Communication System (LMCS) for alarm reporting. The Tektronix M4125 color graphic system was used in place of the Advanced Electronics Design 512 color graphic system for the display of system status and information. A map editor has been written for the Tektronix M4125 which facilitates the development and modification of displays. Substitution of these systems enhanced the flexibility of the SCCS because common problems in physical protection system development are addressed. 3 refs., 4 figs.

36565 **(SAND—87-0180C) Reliable communications in a network with unreliable key distribution centers.** Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870833—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005536.

From Crypto '87; Santa Barbara, CA, USA (16 Aug 1987).

This paper reports on the providing of a means to communicate in secrecy and with authentication in a network with unreliable KDC's, so long as not more than l out of 2l + 1 KDC's become untrustworthy, i.e., of replacing the dependence on an unconditionally trustworthy element(s) with a distributed trust that at least most of the elements will be trustworthy, but without knowing in advance which ones can be trusted. Although we restricted discussion to the simplest example possible of setting up a secure communications link between a and b, the protocol generalizes in an obvious and easy way to set up conference calls among n subscribers. The recovery protocol also generalizes in the obvious way to insure secure conferencing so long as not more than l KDC's have failed.

36566 **(SAND—87-0947C) The evolution of interior intrusion detection technology at Sandia National Laboratories.** Graham, R.H.; Workhoven, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 8p. (CONF-870713—14). NTIS, PC A02. File Number DE87011858.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Interior Intrusion Detection Technology began at Sandia National Laboratories (SNL) in 1975 as part of the Fixed Facilities Physical Protection Research and Development program sponsored by the US Department of Energy in connection with their nuclear safeguards effort. This paper describes the evolution of Interior Intrusion Detection Technology at Sandia National Laboratories from the beginning of the Interior Sensor Laboratory to the present. This Laboratory was established in 1976 to evaluate commercial interior intrusion sensors and to assist in site-specific intrusion detection system designs. Examples of special test techniques and new test equipment that were developed at the Lab are presented, including the Sandia Intruder Motion Simulator (SIMS), the Sensor and Environment Monitor (SEM), and the Sandia Interior Robot (SIR). We also discuss new sensors and unique sensor combination developed when commercial sensors were unavailable and the future application of expert systems. 5 refs.

36567 **(SAND—87-0977C) A performance evaluation of personnel identity verifiers.** Maxwell, R.L.; Wright, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 22p. (CONF-870713—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011855.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Personnel identity verification devices, which are based on the examination and assessment of a body feature or a unique repeatable personal action, are steadily improving. These biometric devices are becoming more practical with respect to accuracy, speed, user compatibility, reliability and cost, but more development is necessary to satisfy the varied and sometimes ill-defined future requirements of the security industry. In an attempt to maintain an awareness of the availability and the capabilities of identity verifiers for the DOE security community, Sandia Laboratories continue to comparatively evaluate the capabilities and improvements of developing devices. An evaluation of several recently available verifiers is discussed in this paper. Operating environments and procedures more typical of physical access control use can reveal performance substantially different from the basic laboratory tests.

36568 **(SAND—87-1022C) Semi-automated reviewing station for IAEA [International Atomic Energy Agency] optical surveillance data.** Darnell, R.A.; Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-870713—12). NTIS, PC A02. File Number DE87011867.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A study is underway on the use of computer vision technology to assist in visual inspection of optical surveillance data. The IAEA currently uses optical surveillance as one of its principal Containment and Surveillance (C/S) measures. The review process is a very time-consuming and tedious task, due to the large amount of optical surveillance data to be reviewed. For some time, the IAEA has identified as one of its principal needs an automated optical surveillance data reviewing station that assists the reviewer in identifying activities of safeguards interest, such as the movement of a very large spent fuel cask. The present development reviewing station consists of commercially available digital image processing hardware controlled by a personal computer. The areas under study include change detection, target discrimination, tracking, and classification. Several algorithms are being evaluated in each of these areas using recorded video tape of safeguards relevant scenes. The computer vision techniques and current status of the studies are discussed.

36569 **(SAND—87-1038C) WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system.** Sanderson, S.N. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 6p. (CONF-870713—11). NTIS, PC A02. File Number DE87011866.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Sandia National Laboratories has developd a remote sensor package that provides a low-cost, convenient way of monitoring item movement. Originally, the package was intended for use in valve monitoring, but it is now possible to use it in any sensor application where hardware installation is impractical or uneconomical. Full system implementation includes a receiver/controller which correlates the arrival time of rf signals generated by item-monitoring transmitters to increase communication security. Wireless Alarm Transmission of Container Handling (WATCH) is such a system. One important application of WATCH is in storage vaults where there are a number of material containers. Applying WATCH to inventory control reduces inventory workload and employee exposure rates; the system also provides quick access to inventory information by interfacing the system with plant site computer systems.

36570 **(SAND—87-1128C) SIR-1: An autonomous mobile sentry robot.** Harrington, J.J.; Klarer, P.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870890—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009290.

From 3. annual Armed Forces Communications Electronics Association and exposition; Philadelphia, PA, USA (4 Aug 1987).

This paper describes a prototype mobile robot system configured to function as part of an overall security system at a high security facility. The features of this robot system include specialized software and sensors for navigation without the need for external locator beacons or sign posts, sensors for remote imaging and intruder detection, and data link facilities to communicate information either directly to an electronic security system or to a manned central control center. Other features of the robot system include low weight, compact size, and low power consumption. The robot system can operate either by remote manual control, or it can operate autonomously where the need for direct human control is limited to the global command level. The robot can act as a mobile remote sensing platform for visual alarm assessment or roving patrol, or as an exploratory device in situations potentially hazardous to humans. This robot system may also be used to walk-test intrusion detection sensors as part of a routine test and maintenance program for an interior intrusion detection system (IDS), and to provide a programmable, temporary sensor capability to backup an IDS sensor that has failed. This capability may also be used to provide improved sensor coverage of an area that will be secured on a temporary or short term basis, thereby eliminating the need for a permanent sensor installation. The hardware, software, and operation of this robot system are briefly described.

36571 **(SAND—87-1224C) Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors.** Mangan, D.L.; Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 9p. (CONF-870519—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009502.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

Recycled plutonium has been used for the production of FBR and LWR fuel assemblies. These assemblies typically contain ~1.5 kg (BWR fuel), 4 kg (PWR fuel) and 14 kg (FBR fuel) of plutonium. The safeguarding of this concentration of plutonium requires more frequent verification than that for low enriched uranium fuel. This situation is of particular concern at LWRs which now use mixed oxide (MOX) fuel, or which, in time, will use such fuel. This paper addresses safeguards measures employing Containment and Surveillance (C/S) techniques which are felt to offer the potential of reduced inspection effort while maintaining the current safeguards timeliness goals for fresh MOX fuel assemblies.

36572 **(UCRL—96407) The Livermore Security Console system.** Smart, J.A. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1987. Contract W-7405-ENG-48. 7p. (CONF-870743—5). NTIS, PC A02. File Number DE87011558.

From Carnahan conference on security technology; Atlanta, GA, USA (15 Jul 1987).

The Console system contains multiple, redundant workstations that enable operator to monitor alarms, assess incidents, and dispatch field personnel. Each workstation is heavily computerized and incorporates automatic video switching and recording, integrated radio and telephone communications, and an advanced high-resolution map and incident-display system. Operation of the workstation is closely integrated with the map display system, allowing an operators to readily pan and zoom. Objects of security interest are overlaid on the map using color. Access to alarm sensor information, entry-control device status, and the closed-circuit television system is obtained by zooming into an area and selecting the appropriate icons or symbols on the maps. Control menus are overlaid on the map. Several large databases have been closely integrated with the map display system, providing access to information such as telephone numbers and building or room occupants. An expert system is currently being integrated with the map display system. Object state changes are interpreted by a rule-based inference engine. Incidents are overlaid on the map.

36573 **(Y/DS—254) Statistically stable branch method for improving accountability and control.** Gray, J.R.; Younkin, J.M. (Oak Ridge Y-12 Plant, TN (USA)). 22 Jan 1987. Contract AC05-84OS21400. 6p. (CONF-870713—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005738.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The statistically stable branch (SSB) method is a quantitative management technique. The "invention" of the method was motivated by a perceived need for a systematic and efficient means for continually improving the special nuclear material (SNM) accountability and control systems of the Oak Ridge Y-12 Plant. The SSB method consists of six main components - analysis, synthesis, establishment of priorities, branch models, performance assessment, and performance improvement - which are integrated to satisfy this need. This integration is facilitated by a unique form of the classical inventory difference (ID) equation which we call the SSB ID equation. This equation is used as a guide when the network of material movements within a material balance area (MBA) is dissected into "branches." By proper definition, these branches are aligned with terms in the fundamental SSB ID equation. Once this alignment is obtained, the SSB ID equation is used to prove that the behavior of an MBA ID is improved by improving the behavior of its branches. Among other things, the method offers a better definition and assessment of the statistical control of the accountability and control processes. It also promotes efficient use of resources by identifying and ranking potential improvement opportunities and provides a clear, quantitative goal by which one can gauge the progress of improvement efforts.

### 0560 Legislation And Regulations

*REFER ALSO TO CITATION(S) 36543*

## 07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

### 0703 Isotopic Power Supplies

36574 **(CONF-870804—18) Assessment of radioisotope heaters for remote terrestrial applications.** Uherka, K.L. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011386.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

This paper examines the feasibility of using radioisotope by-products for special heating applications at remote sites in Alaska and other cold regions. The investigation included assessment of candidate radioisotope materials for heater applications, identification of the most promising cold region applications, evaluation of key technical issues and implementation constraints, and development of conceptual heater designs for candidate applications. Strontium-90 (Sr-90) was selected as the most viable fuel for radioisotopic heaters used in terrestrial applications. Opportunities for the application of radioisotopic heaters were determined through site visits to representative Alaska installations. Candidate heater applications included water storage tanks, sludge digesters, sewage lagoons, water piping systems, well-head pumping stations, emergency shelters, and fuel storage tank deicers. Radioisotopic heaters for water storage tank freeze-up protection and for enhancement of biological waste treatment processes at remote sites were selected as the most promising applications.

## 08 HYDROGEN

### 0801 Production

36575 **(EUR—10775-EN) Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report.** Vandenborre, H. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1986. 69p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

It was the aim of the project to develop and to test a prototype electrolyser based on Inorganic-Membrane-Electrolyte (I.M.E.)-technology, producing hydrogen at a production rate of 25 Nm/sup 3/h/sup -1/ and operating at 0.5 MPa pressure with a current density of 10,000 Am/sup -2/ and a target cell voltage of 1.75 V at temperatures below 120/sup 0/C. The I.M.E.-technology uses a patented separator and catalytically activated electrodes, pressed against the separator.

36576 **(EUR—10890-EN) Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report.** Lehn, J.M.; Sauvage, J.P.; Ziessel, R.; Hilaire, L.; Dietrich-Buchecker, C.O.; Edel, A.; Marnot, P.A.; Keller, P.; Moradpour, A. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Strasbourg-1 Univ., 67 (France); Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides). 1987. 48p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

This work deals with a) a study of strontium titanate, modified by deposition of rhodium, b) a study of ruthenium dioxide as a redox catalyst for the generation of H/sub 2/ from water, and c) the synthesis and a study of new photosensitizers based an highly rigid copper (I) complexes.

36577 **(Juel—2090) Porosity and pressure drop of a Raschig-ring-bed.** Achenbach, E.; Mueller, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Oct 1986. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770178.

The paper is concerned with the experimental determination of the integral and local porosity distribution of a Raschig-ring-bed. The hollow cylindrical particles have a nominal size of d/sub a//h/d/sub i/=10/10/4 mm. The effects of the frontal boundaries of the bed and the ratio of tube to particle diameter as well on the total porosity are considered. The results are approximated by empirical equations. The local distribution of the porosity near the wall was measured by three different methods. The optical procedure was most reliable and less time consuming. The porosity in the vicinity of the wall is higher than in the centre of the bed. The resulting bypass-effect is estimated here. The pressure drop was measured in the range of Reynolds number $50<Re<2.5 \times 10/sup 3/$ for different geometrical sizes of the bed. The experimental results agree reasonably with those calculated from the correlations given in a recent publication /12/.

36578 **(PB—87-182192/XAB) Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986.** Sammells, A.F.; Cook, R.L.; Wessels, B.W.; Dempsey, P.F.; Pons, S. (Eltron Research, Inc., Aurora, IL (USA)). Dec 1986. 113p. NTIS, PC A06/MF A01.

See also report dated Nov 1985, PB—86-174356.

A detailed characterization of the electronic, chemical, and structural interfacial characteristics of p-InP in aqueous electrolytes was performed to provide a clearer understanding of its behavior so that systematic improvements in performance could be made. Measurement techniques for the in-situ detection of molecular-level photoelectrode/electrolyte interface parameters were employed. Techniques used to address this included classical electrochemical measurements, transient laser-pulse-induced photopotential and photocurrent measurements, together with photocapacitance, Raman, Auger and FTIR spectroscopy. Interfacial parameters investigated included charge-carrier energetics, the energies and densities of electronic surface states, photoelectrode kinetics, and interfacial molecular structure. This insight suggested new surface modifications strategies and PEC cell designs for efficient hydrogen evolution from aqueous electrolytes. In the absence of suitable surface modifications, p-InP can possess poor energetics and kinetics for small-molecule multielectron redox reactions such as hydrogen evolution.

### 0806 Industrial And Commercial Use

*REFER ALSO TO CITATION(S) 36579*

### 0808 Properties

36579 **(SAND—86-0173) Flame acceleration in mixtures of hydrogen and air.** Cummings, J.C.; Torczynski, J.R.; Benedick, W.B. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011907.

Turbulence and acoustic instabilities can play important roles in the development of combustion-generated pressure for both closed and vented vessels. Given the proper conditions, it has been observed experimentally that the standard explosion venting guidelines can be rendered invalid. This report summarizes the results of a series of experiments conducted for the purpose of studying the acceleration of flames in mixtures of hydrogen and air. The acceleration of these flames caused combustion-generated pressures to significantly exceed the explosion venting guidelines. The report reviews the analysis required to predict the pressure history within closed or vented vessels due to combustion. A simple numerical model is developed and calculational results are compared to the experimental data.

## 09 OTHER SYNTHETIC AND NATURAL FUELS

### 0901 Hydrocarbon Fuels

*REFER ALSO TO CITATION(S) 36580*

36580 **(BMFT-FB-T—86-147) Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report.** Rettenberger, G.; Tabasaran, O. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770171.

The report describes the investigation program, which was performed at the gas recovery and utilization plant 'Am Lemberg'. The program was established to find out what happens to a landfill when a gas recovery system has been installed, f.e. how is the behaviour of the emissions, migration and the gas phase in the landfill. Further investigations dealt with the gas utilization plant (f.e. condensate, trace constituents in the landfill gas, corrosion problems).

36581 **(CONF-861288—1) Slurry-phase Fischer-Tropsch synthesis.** Zarochak, M.F.; McDonald, M.A. (USDOE Pittsburgh Energy Technology Center, PA). 1986. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011758.

From Indirect liquefaction contractors' conference; Monroeville, PA, USA (2 Dec 1986).

Fischer-Tropsch synthesis in the slurry phase has attracted attention in recent years due to its numerous advantages. Among these advantages are the ability of the liquid phase to handle the large heats of reaction and thereby control reaction temperature, the ability to handle low $H_2/CO$ ratio synthesis gas without needing a preliminary water-gas shift step, and the relatively low capital and operating costs for slurry systems. Slurry-phase work at PETC has focused on understanding effects of catalyst preparation and pretreatment, of reaction conditions (T, P, $H_2/CO$), and of operating conditions (space velocity, methods of wax removal) on catalyst synthesis behavior (activity, selectivity, and maintenance of activity and selectivity). Better understanding of the effects of these factors on F-T synthesis leads to improvements in process technology. This work focuses on the effects of catalyst pretreatment on synthesis behavior. Developing an effective F-T catalyst pretreatment procedure is a problem limited almost exclusively to iron catalysts. This paper reports some recent results on the effects of pretreatment. Synthesis runs were made using one of two different pretreatments given a potassium-promoted precipitated iron catalyst. Besides these reaction experiments, catalyst samples were periodically withdrawn from the stirred autoclave for characterization by means of Moessbauer spectroscopy.

36582 **(DOE/PC/80011—T1) Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987.** Withers, H.P.; Bukur, D.B.; Rosynek, M.P. (Air Products and Chemicals, Inc., Allentown, PA (USA); Texas A and M Univ., College Station (USA)). 23 Mar 1987. Contract AC22-85PC80011. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012079.

A literature search of precipitated iron/copper/potassium catalyst has been completed. A catalyst precipitation unit has been assembled and tested. A pure precipitated iron catalyst has been synthesized and its BET surface area and temperature-programmed reduction (TPR) behavior have been determined. All equipment supplied by APCI has been made operational. The design of two new reactor systems (slurry and fixed bed) has been completed, and some of the equipment and parts necessary for their construction have arrived. Progress has been made in the areas of chromatograph calibrations and data reduction software. 24 refs., 6 figs., 8 tabs.

36583 **(DOE/PC/80016—T3) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986.** Tong, G.T.; Wilson, R.B.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 17 Apr 1987. Contract AC22-85PC80016. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010705.

Surface-confined ruthenium cluster catalysts have been prepared with alumina, Y-zeolite, and molecular sieve supports. The Al-$Ru_4$ and Al-$Ru_6$ hydridocarbonyl cluster complexes previously used to prepare alumina-supported cluster catalysts were used in similar surface-confining reactions with sodium Y-zeolite and molecular sieve zeolite supports. Infrared (FTIR) spectra, gas evolution, and elemental analysis were used to follow the surface-confining reaction. In all cases, the confined complexes of Al-$Ru_4$ and Al-$Ru_6$ had the composition -O-Al($C_2H_5$)[(H)$Ru_4(CO)_{12}$] and -O-Al($C_2H_5$)[(H)$Ru_6(CO)_{18}$], respectively. Monomeric ruthenium catalysts have also been prepared for all three supports by surface confining reactions with the complex (allyl)$_2$Ru(CO)$_2$. The support material has been shown to alter the inherent activity and selectivity of ruthenium Fischer-Tropsch synthesis (FTS) catalysts, and it may affect the stability of the ruthenium clusters during activation and FTS reaction. The series of Ru cluster catalysts ranges from one, four, and six atoms confined on surfaces of three supports with variable acidity and porosity, beta alumina, sodium Y-zeolite, and molecular sieve zeolite. These catalysts will be tested for FTS activity and selectivity for syn gas with $H_2/CO = 1.0$ at 1 atm using

a hot wax trap to determine if a catalyst shows a decline in the Schultz-Flory Anderson product distribution above decane. A potassium and copper doubly-promoted precipitated iron catalyst was prepared for evaluation of the effect of sulfur treatment on the methane selectivity and olefin-to-paraffin ratio of light hydrocarbons. 9 refs.

36584 **(DOE/PC/80016—T4) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987.** Tong, G.T.; Wilson, R.B.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 9 Jun 1987. Contract AC22-85PC80016. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012047.

Six surface-confined ruthenium cluster catalysts supported on alumina, sodium-Y zeolite, and molecular-sieve supports were tested for Fischer-Tropsch synthesis (FTS) activity and for methane and olefin-to-paraffin selectivity for syn gas with $H_2/CO = 1.0$ at 100 kPa and 523 K. The tetraruthenium cluster catalyst supported on alumina had the highest FTS activity with a methane selectivity of 61%. The hexaruthenium cluster catalyst supported on sodium-Y zeolite had the lowest methane selectivity (36%) and the highest olefin selectivity (ethylene/ethane > 20). The Schulz-Flory product distribution and chain growth factors for all ruthenium cluster catalysts through $C_6$ were nearly independent of support type and cluster size. An unpromoted FTS cobalt catalyst supported on alumina was prepared to evaluate the effect of sulfur treatment on the methane selectivity and olefin-to-paraffin ratio of light hydrocarbons. A low-level sulfur-treated fused iron catalyst (20% monolayer sulfur coverage) was prepared and tested for FTS activity ad selectivity for syn gas with $H_2/CO = 1.0$ at 100 kPa and 573 K. This sulfur-treated catalyst showed almost a twofold reduction in methane yield compared with the clean fused iron catalyst. The sulfur-treated catalyst also demonstrated good stability, showing no sign of deactivation throughout a 24-h synthesis run. Final FTS testing with sulfur-treated cobalt and the remaining ruthenium monomer catalysts will complete the screening phase of this project. 5 figs., 2 tabs.

36585 **(ETSU-B—1052) Report on anaerobic digestion of dairy cattle wastes to October 1981.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Rowett Research Inst., Aberdeen (UK); North of Scotland Coll. of Agriculture, Aberdeen (UK). Engineering Div.). 1987. 17p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

UK pilot plant and full scale studies using whole dairy and fattening cattle wastes are described, and digesters, gas production, pollution reduction and microbiological experiments are discussed. The results presented indicate that whole dairy wastes give a lower gas production, although the methane content is the same as that for fattening cattle wastes.

36586 **(ETSU-B—1077) Limits to process intensity in methane (biogas) generator systems.** Franco, C. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 76p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Simple biogas reactors were set up to test various key design and operating principles using cellulosic substrates. Ten key internal parameters were monitored to characterise the performance of the reactor. A simple laboratory scale, two-stage digester was then constructed to test further the design principles developed from the above tests and the reactor feed was supplemented with acetate. Net energy generation calculations were performed for different loading rates, feed dilutions and operating temperatures.

36587 **(ETSU-B—7006) Survey of existing methods of biogas scrubbing and utilisation.** Meynell, P.J.; Coombs, J. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 145p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the technical and economic aspects of the removal of impurities from biogas generated during the anaerobic digestion of wastes and other organic materials. After discussing the nature and sources of biogas, possible corrosion and environmental problems are outlined. The principles and current practice in gas clearing procedures worldwide are described. Finally the economics and areas where research and development are required are outlined.

36588 **(PB—87-173886/XAB) Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report.** Bhattacharya, S.K.; Parkin, G.F. (Drexel Univ., Philadelphia, PA (USA). Dept. of Civil Engineering). Jun 1986. 295p. NTIS, PC A13/MF A01.

The specific objectives of this research were: (1) quantify the change in kinetics of anaerobic utilization of acetate and propionate caused by addition of selected toxicants (both slug and continuous addition of toxicants were studied); and (2) study the fate of selected toxicants during anaerobic utilization of acetate and propionate in a defined nutrient media. The selected toxicants were ammonia, nickel, formaldehyde, and methylene chloride. Ammonia toxicity is a relatively common problem in anaerobic treatment, especially during the treatment of protein wastes. Nickel, along with being a representative heavy-metal toxicant, is a required nutrient for methanogens. Formaldehyde and methylene chloride were selected to represent the wide variety of toxic, potentially biodegradable organics. Methylene chloride specifically represents the family of chlorinated organics that are of public health concern.

36589 **(PB—87-181095/XAB) STORS: Battelle-Northwest's sludge-to-oil reactor system.** Molton, P.; Fassbender, A.; Brown, M. (Battelle Memorial Inst., Richland, WA (USA)). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Proceedings of the National Conference on Municipal Treatment Plant Sludge Management, Orlando, FL., May 28-30 1986, 272-278.

A continuous primary sewage sludge thermochemical-conversion system was designed, built, and operated for over 100 hr during 1984 at Battelle-Northwest. This was designated as the STORS (Sludge-to-Oil-Reactor System), because the major product was a burnable oil. Starting with 20% solids primary sludge, mixed with 5% by weight of sodium carbonate and heated to 300 C, products obtained included a pourable oil, a char containing most of the inorganic materials, some gas, and an aqueous phase containing most of the inorganic materials, some gas, and an aqueous phase containing dissolved organics and salts. The oil and char under certain conditions separated spontaneously from the aqueous phase. The energy recovery in burnable products reached 73% of the initial energy in the wet sludge, the oil having the highest energy density with approximately 90% of the heating value of diesel fuel.

36590 **(PB—87-184115/XAB) Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation).** Nakagawa, C.H.; Honquilada, Q.L. (Peace Corps, Washington, DC (USA). Information Collection and Exchange). Jul 1985. 103p. (PC/ICE/R—51). NTIS, PC A06/MF A01.

This report gives a thorough description of a Philippine biogas project. It provides basic knowledge and guidance for the construction and operation of a small-scale family-size biogas unit. The report includes benefits of installation and a general overview of the construction process: structural features/considerations, planning/preparation, site consideration and operation and maintenance provisions. Contains numerous sketches, design diagrams, appendices and a reference bibliography.

36591 **(PNL-SA—14315) Product analysis from direct liquefaction of several high-moisture biomass feedstocks.** Elliott, D.C.; Sealock, L.J. Jr.; Butner, R.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 10p. (CONF-870410—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011153.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The carbohydrate structures found in biomass can be converted thermochemically to a mixture of primarily phenolic compounds. Hydro carbons are not predominant yet they may survive

the processing in a significant yield given an appropriate feedstock. Cyclic ketones are the other major component group which can be identified by GC/MS. Low molecular weight oxygenates and furans are minimized by the addition of base to the reaction medium. The product compositions of the napier grass and sorghum-derived product oils shown many similarities to wood-derived oils. In comparing with high-pressure processed oil from Douglas fir the same groups of cyclic ketones, phenols, naphthols, and dihydroxybenzenes dominate. The traces of hydrocarbon in the sorghum and napier grass oils are apparently feedstock related. Nitrogen-containing compounds were not found in the sorghum or napier grass oils reported here. The large fraction of nitrogen-containing cyclic compounds is the distinguishing factor between the hyacinth, kelp and grain oils when compared to earlier wood oil analyses. Similar compounds were found earlier in peat and sewage sludge oils. 20 refs., 4 tabs.

**36592 (PNL-SA—14377) Catalytic hydrotreating of biomass-derived oils.** Baker, E.G.; Elliott, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 8p. (CONF-870410—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011148.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A variety of biomass-derived oils have been upgraded by catalytic hydrotreating in a 1-liter reactor system. High yields of high quality gasoline ($C_5$-225°C boiling range) can be produced from biomass-derived oils, however, low space velocities (long residence times) are required. At high space velocities a low oxygen, highly aromatic crude oil is produced. Cracking and hydrogenation of the higher molecular weight components are the rate limiting steps in upgrading biomass-derived oils. Catalyst development should be directed at these reactions. The TR7 oil is superior to TR12 and both are much superior to pyrolysis oils as feedstocks for catalytic hydrotreating to produce hydrocarbon fuels. Pyrolysis oils can be upgraded by catalytic hydrotreating; however, a catalytic pretreatment step is required. Residual sodium catalyst needs to be removed from liquefaction products to prevent rapid catalyst fouling.

**36593 (SAND—87-0682C) Nickel site of methane catalysis in the methyl reductase enzyme.** Shelnutt, J.A.; Shiemke, A.K.; Scott, R.A. (Sandia National Labs., Albuquerque, NM (USA); Illinois Univ., Urbana (USA)). 30 Aug 1987. Contract AC04-76DP00789. 8p. (CONF-870802—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008510.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The nickel-tetrapyrrole derivative in the methyl-reductase enzyme resides in a unique protein environment. The Raman data suggest that $F_{430}$ in the protein has at least one axial ligand and occupies a site in the protein with a low degree of heterogeneity. The free form of $F_{430}$ shows evidence of ruffling in that multiple forms are observed in the low temperature Raman spectrum and the species cannot all be ascribed to axial ligand complexes. This low temperature behavior is also noted for the model nickel-corphinoid in non-coordinating solvents such as methylene chloride. Salt-extracted $F_{430}$ higher affinity for axial ligands than the diepimer. The axial coordination sites of nickel may serve as a binding site for methyl-S-CoM or perhaps the methyl group that is reduced to methane in the reaction. Nickel corphinoids are known to have higher affinity for axial ligands than nickel prophyrins and the unusual affinity may play a role in methane catalysis. The nickel corphinoids also exhibit different behavior in the photolysis of axial ligands than the nickel porphyrins. A Ni(I) intermediate may be involved in the reduction of the bound methyl group to methane. Macrocycle flexibility may also play a role in methane catalysis. In these reactions an axial Co-$CH_3$ complex is known to be an intermediate.

**36594 Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts.** Huang, Y.J.R.; Schwarz, J.A. (Dept. of Chemical Engineering and Materials Science, Syracuse Univ., Syracuse, NY 13244). *Industrial and Engineering Chemistry Research;* **26**: No. 2, 379-382(Feb 1987).

This paper examines two recent models. The first considers a direct surface suppression of active catalytic centers by the deposition of carbon. The second proposes a change in a rate constant for one of the steps in the model for the mechanism. Neither proposal has been confirmed experimentally. A variation of the multiple-cycle transient analysis (MCTA) technique has been employed to determine which model is valid. In this study the temperature of the catalyst bed is modulated in the form of a sinusoidal wave. The time-dependent methane signal becomes asymmetric at the transition temperature, 473 K. Comparison between experimental and predicted results demonstrates that the surface suppression model due to carbon deposition does not provide adequate agreement. The hydrogenation of carbon monoxide over Ni/SiO/sub 2/ catalysts at a high H/sub 2//CO ratio has revealed a reversible change in the rate of methane formation at 473 K.

**36595 Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling.** Dun, J.W.; Gulari, E. New York, NY; American Institute of Chemical Engineers (1985). 23p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Forced concentration cycling of the feed between pure CO and pure H/sub 2/ was used to successfully change both the selectivities and reactivities of promoted and unpromoted charcoal supported molybdenum catalysts in Fischer-Tropsch synthesis. It was found that with the unpromoted catalyst the rate enhancement increases with temperature and selectivity shifts towards methane. At the lower temperatures concentration cycling increases selectivity to ethane and higher hydrocarbons to levels only achievable with promised catalysts. Periodic operation with the potassium promoted catalyst results in small rate enhancements but the olefin to paraffin ratio is dramatically changed without changing the carbon number distribution.

## 0902 Alcohol Fuels

*REFER ALSO TO CITATION(S) 36992*

**36596 (BMFT-FB-T—86-158) Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report.** Butzke, R.; Mauch, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770170.

A three-stage concept is presented for the biotechnical utilization of solid and liquid waste products as obtained from the process of sugar manufacture. A mixed culture-consisting of bacteria that are both thermophilic and cellulolytic-hydrolyses the extracted cossettes into acetate and ethanol. In a second phase, waste water, that contains sucrose, can be fermented simultaneously into ethanol, for which yeast is employed. The outlets of both stages are then combined to produce biogas by means of methanization. The focal point in the investigations for phase II rested on a long-time experiment - carried out under industrial conditions - in which a pilot plant was involved. In comparison to the mesophilic fermentation of cossettes, the thermophilic procedure was less complicated and tended to break-down far less frequently. The testing of the ethanolic fermentation of waste water proved to be successful. Finally, it could be shown, that the conditions required for the integration of the described concept into an existing system of waste water treatment in a sugar factory are at hand. With 16 refs., 9 tabs., 21 figs.

**36597 (DOE/PC/70780—T7) Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987.** Bischoff, K.B.; Manogue, W.H.; Mills, G.A.; Bhore, N. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology). 25 Jun 1987. Contract FG22-84PC70780. 20p. NTIS, PC A02. File Number DE87011626.

Changes in the chemical state of Rh and Mo, and the dispersion of Mo due to different treatments and Mo loadings was studied by X-Ray Phototelectron Spectroscopy. The results show well dispersed Mo on $Mo/Al_2O_3$ and aggregated Mo on $Rh-Mo/Al_2O_3$.

The crystallite size of Mo-oxide particles in Rh-Mo/$Al_2O_3$ was estimated using Kerkhof and Moulijn method to be ~ 20A. Electron Spin Resonance Spectroscopy measurements on catalysts show presence of paramagnetic Mo species on reduction and corroborate XPS results. Mo and Rh loadings were determined by X-Ray Fluorescence. Ethylene hydrogenation was carried out on Rh/$Al_2O_3$, Mo/$Al_2O_3$ and Rh-Mo/$Al_2O_3$ in the presence and in the absence of carbon monoxide in the gas phase. Carbon monoxide in the gas phase acts as an ON/OFF switch for ethylene hydrogenation on Rh/$Al_2O_3$. Rh-Mo/$Al_2O_3$ acts like Rh/$Al_2O_3$ for ethylene hydrogenation in the absence of carbon monoxide and like Mo/$Al_2O_3$ in the presence of carbon monoxide.

36598 **(IFP—34-367-1) Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1.** Grandvallet, P. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). Jun 1985. 274p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752314.

After a bibliographic review of synthesis CO/H/sub 2/, the preparation of cobalt and copper base catalysts and reduction of Cu and Co oxides in mixed solutions with alumina (which is the support) is studied. Catalyst preparation by thermal decomposition of citric complexes was abandoned because of copper sintering. Catalyst is prepared by coprecipitation of nitrates by sodium carbonate, oxides are obtained by carbonate decomposition and these oxides are reduced by hydrogen at 400-500 /sup 0/C. Kinetics of methanol decomposition at atmospheric pressure is examined to test the catalysts. Kinetics of alcohol synthesis under pressure is studied, alkalinization of the catalyst is necessary for neutralization of residual acidity. The consequence is a relatively selective synthesis for C/sub 2/ to C/sub 6/ alcohols, hydrocarbons are also produced. Formation of C/sub 1/ to C/sub 3/ alcohols in respect to ≧ C/sub 4/ and correspondence of formation of C/sub n/ hydrocarbons with C/sub n+1/ OH alcohols are observed. There is a competition between the formation of methanol and CO/sub 2/ . 323 refs.

36599 **(IFP—34-367-2) Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2.** Grandvallet, P. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). Jun 1985. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752315.

The second volume includes appendices. Experimental techniques are presented: catalyst preparation and characterization (by ESCA, magnetic susceptibility and STEM), catalyst testing, chromatographic techniques, methanol decomposition, technology of synthesis under pressure from CO and H/sub 2/. Catalyst precursors in spinel phase and hydroxycarbonate phase obtained by coprecipitation are described. Transformation of hydroxycarbonates into mixed oxides by thermal activation is presented. Distribution obtained in Fisher -Tropsch synthesis is explained by mathematical equations in stationary and non stationary states.

36600 **(SAND—87-0683C) The testing of catalysts for alkane activation.** Stohl, F.V.; Shelnutt, J.A.; Granoff, B.; Trudell, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870802—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008509.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Results of the cyclohexane tests carried out for longer times indicate that it is necessary to determine what happens to the oxidant during the reaction, since results suggest that oxidant is depleted even at low alcohol yields. If a more effective oxidant is found, yields should be significantly higher. Results with butane suggest that we may have a good test procedure for use with shorter chain alkanes. To be able to compare results from tests using cyclohexane and hexane to butane (and to future tests with ethane and methane), it will be necessary to determine the effects of different reactant concentrations and different reaction times and temperatures.

36601 **(SERI/SP—231-2878) SERI Biochemical Conversion Program: 1985 annual report.** (Solar Energy Research Inst., Golden, CO (USA)). May 1987. Contract AC02-83CH10093. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001170.

The objective of the Biochemical Conversion Program is to develop the technology for the conversion of lignocellulosic materials to liquid fuels (primarily ethanol) and to facilitate the adoption of the technology by private industry. The program is divided into engineering research, ethanol production, and technology evaluation. The engineering research task focuses primarily on acid hydrolysis. The major problems involve engineering development to provide a system with known performance and costs. In dilute-acid hydrolysis systems, conditions severe enough to break down crystalline cellulose are severe enough to degrade the glucose product. The ethanol production research task includes research on enzymatic hydrolysis with fungal and bacterial enzymes, pretreatment, and enzyme production research, research on using the xylose and lignin fractions of the feedstock, and minor efforts on ethanol separation technology. 36 refs., 66 figs., 15 tabs.

36602 **(STEV-BF—87-4) Controlling of processes for producing energy carriers by means of biotechnique.** Mandenius, C.F. (Statens Energiverk, Stockholm (Sweden)). 1987. 61p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752401.

The most suitable parameter to reducing production cost is controlling of sugar content when converting sulfite lye or cellulose hydrolysate to ethanol. By keeping the sugar content low in the end product the yield and productivity are improved. A sensor for ethanol in the yeast tank has been developed and the continous analysis of glucose has been performed by means of an analyser for enzymes.

36603 **(UCRL—95798) Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures.** Colmenares, C.A.; McCreary, T.; Evans, C. (Lawrence Livermore National Lab., CA (USA)). 19 Mar 1987. Contract W-7405-ENG-48. 12p. (CONF-870443—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010878.

From 2. international conference on the basic and applied chemistry of f-transition and related elements; Lisbon, Portugal (6 Apr 1987).

High surface area $ThO_2$ catalysts (~120-150 $m^2/g$), pure and doped with 100 ppM K, 1000 ppM K, 74 ppM Rb, and 100 ppM Pd by weight, have been tested with a mixture of $2H_2$:1CO (~45 atm, 550 to 623°K) for their ability to produce methanol and other hydrocarbons in a differential high-pressure flow reactor. Pure $ThO_2$ was active for the production of mostly methanol (0.74 mole/kg cat.-h, 85 to 95% selectivity) and small amounts of isobutyl alcohol, isobutane, and ethane/ethene. Thoria doped with 100 ppM K nearly doubled the production rate of methanol over that for pure $ThO_2$ with a 99% selectivity for this product. Increasing the K to 1000 ppM decreased the methanol production by a factor of 67 from that for the 100 ppM K catalyst, but it was still the main product (89%) at 577°K. Other significant products were ethylene and methane. As the temperature was raised above 739°K the amount of methanol produced was negligible and the distribution of the main products was: 34.2% methane, 27.4% propane, 23.9% ethane, 5.6% 1-butene, and 4.4% n-butane. Catalysts with 74 ppM Rb and 100 ppM Pd increased the methanol yield by 15 and 12%, respectively, over that for $ThO_2$ and their selectivities for methanol were about 98 and 90%, respectively. X-ray photoelectron spectroscopy analyses of the doped catalyst did not show a preferential segregation of the dopants to the surface, indicating that they possibly are in substitutional lattice positions.

36604 **Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi.** Goodwin, S.; Zeikus, J.G. (Univ. of Wisconsin, Madison). *Journal of Bacteriology;* **169**: No. 5, 2150-2157(May 1987). Contract FG02-85ER13376.

Detailed physiological studies were done to compare the influence of environmental pH and fermentation end product formation on metabolism, growth, and proton motive force in Sarcina

ventriculi. The kinetics of end product formation during glucose fermentation in unbuffered batch cultures shifted from hydrogen-acetate production to ethanol production as the medium pH dropped from 7.0 to 3.3. At a constant pH of 3.0, the production of acetate ceased when the accumulation of acetate in the medium reached 40 mmol/liter. At a constant pH of 7.0, acetate production continued throughout the entire growth time course. The in vivo hydrogenase activity was much higher in cells grown at pH 7.0 than at pH 3.0. The magnitude of the proton motive force increased in relation to a decrease of the medium pH from 7.5 to 3.0. When the organism was grown at pH 3.0, the cytoplasmic pH was 4.25 and the organism was unable to exclude acetic acid or butyric acid from the cytoplasm. Addition of acetic acid, but not hydrogen or ethanol, inhibited growth and resulted in proton motive force dissipation and the accumulation of acetic acid in the cytoplasm. The results indicate that S. ventriculi is an acidophile that can continue to produce ethanol at low cytoplasmic pH values. Both the ability to shift to ethanol production and the ability to continue to ferment glucose while cytoplasmic pH values are low adapt S. ventriculi for growth at low pH.

36605 **Stability and composition of palm, coconut and soy oil fatty acid microemulsion diesel fuels.** Compere, A.L.; Griffith, W.L.; Googin, J.M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN). pp 355-360 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Microemulsion fuels containing fully and partially neutralized coconut, palm, and soy fatty acids; varying amounts of C/sub 1/ to C/sub 4/ alcohols; varying amounts of water, and four fuel bases were evaluated between 0 and 60°C for stability as a single phase system. In general, ability to form a stable single phase system rose with increasing alcohol chain length, decreasing water, and increasing dispersed phase content. It was possible to form 0 to 60°C stable single phase systems in all four fuels tested using 30 to 50% v/v dispersed phase containing 1-butanol and either palm or soy fatty acids.

### 0904 Solid Waste And Wood Fuels

*REFER ALSO TO CITATION(S) 36278, 36335, 36639*

36606 **(PB—87-177523/XAB) Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984.** Castaldini, C.; Waterland, L.R. (Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.). Mar 1987. 112p. (TR—82-98/EE-VOL-1). NTIS, PC A06/MF A01.

See Volume 2, PB—87-177531.

The two-volume report gives results from field tests of a wood-waste-fired industrial watertube boiler. Two series of tests were performed: one firing dry (11% moisture) wood waste, and the other firing green (34% moisture) wood waste. Emission measurements included: continuous monitoring of flue-gas emissions; source-assessment sampling system (SASS) sampling of the flue gas with subsequent laboratory analysis of samples to give total flue-gas organics in two boiling-point ranges, compound category information within these ranges, specific quantitation of the semi-volatile organic priority pollutants, and flue-gas concentrations of 73 trace elements; Method 5 sampling for particulate; controlled condensation system sampling for $SO_2$ and $SO_3$; and grab sampling of boiler mechanical collector hopper ash for inorganic composition determinations. Total organic emissions decreased from 60-135 mg/dscm firing dry wood to 2-65 mg/dscm firing green wood, in parallel with corresponding boiler CO emissions.

36607 **(PB—87-177531/XAB) Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984.** Castaldini, C.; Waterland, L.R. (Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.). Mar 1987. 492p. (TR—82-98/EE-VOL-2). NTIS, PC A21/MF A01.

See also Volume 1, PB—87-177523.

The two-volume report gives results from field tests of a wood-waste-fired industrial watertube boiler. Two series of tests were performed: one firing dry (11% moisture) wood waste, and the other firing green (34% moisture) wood waste. Emission measurements included: continuous monitoring of flue-gas emissions; source-assessment sampling system (SASS) sampling of the flue-gas with subsequent laboratory analysis of samples to give total flue-gas organics in two boiling-point ranges, compound category information within these ranges, specific quantitation of the semi-volatile organic priority pollutants, and flue gas concentrations of 73 trace elements; Method 5 sampling for particulate; controlled condensation system sampling for $SO_2$ and $SO_3$; and grab sampling of boiler mechanical collector hopper ash for inorganic and organic composition determinations. Total organic emissions decreased from 60-135 mg/dscm firing dry wood to 2-65 mg/dscm firing green wood, in parallel with corresponding boiler CO emissions.

36608 **Waste fuels: A proven source of energy recovery.** Santoleri, J.J. (Four Nines, Inc., Plymouth Meeting, PA). pp 35-44 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The Resource Conservation and Recovery Act (RCRA) has established the regulations for burning of hazardous wastes in incinerators. The use of other methods of disposal such as landfills, land treatment, chemical treatment, deepwell, etc., has become less attractive due to the stringent regulations that have been applied to these methods. As a result, the costs of these methods have escalated. Many plant operators have looked to disposal of their wastes in boilers mixed with fossil fuels such as diesel oil, No. 6 fuel oil, and tars. At present this method of disposal is not regulated. The EPA is presently reviewing the need for regulation of this method of disposal to insure that the toxic materials are being destructed at the 99.99% Destruction and Removal Efficiency (DRE) as required by incineration systems.

## 13 HYDRO ENERGY

### 1301 Resources And Availability

36609 **(EFI-TR—3336) Model with two reservoirs used in a multisystem model.** Hirsch, R.v.; Haugstad, A. (Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). 17 Jul 1986. 99p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752494.

A model with two water reservoirs has been developed for production planning and simulation of hydroelectric power systems. It may be used in a multireservoir system. The model is described, and some results from its application are presented.

36610 **(EPRI-P—5201) Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report.** Lettenmaier, D.P.; Leytham, K.M.; Palmer, R.N.; Lund, J.R.; Burges, S.J. (Washington Univ., Seattle (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 364p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920490.

Drought can have significant direct and indirect effects on both steam electric and hydroelectric generation. A previous report evaluated the extent of drought problems affecting the electric utility industry. Three areas were targeted for future research development: (1) Development of improved techniques for estimating drought probabilities; (2) Development of improved methods for estimating the extent and severity of regional droughts, and (3) development of improved drought management, or drought contingency planning, strategies. In this report we describe the use of synthetic (stochastic) streamflow generation coupled with system simulation modeling as an approach for drought probability and system reliability estimation. Regional drought modeling is approached through a new class of stochastic streamflow generation models, based on lognormal mixture distributions. Finally, operational management issues are addressed through multiobjective planning methods. 150 refs., 44 figs., 32 tabs.

## 1302 Site Geology And Meteorology

*REFER ALSO TO CITATION(S) 38038*

36611 **(NEI-DK—23) Complementary preliminary investigastions. Hydroelectric power. Paakitsup Akuliarusersua, Fall 1986.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Mar 1987. 120p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752368.

This report summarizes results of the preliminary studies preceding establishment of a hydroelectric power plant at Paakitsup. There are surveyed possibilities of harbor construction, land transportation, and helicopter landing Wind situation in the valley is mapped, water level variations are evaluated. (EG).

36612 **(NEI-DK—24) Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Text.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Dec 1986. 64p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752369.

The preliminary hydrological and construction-technical studies for a hydroelectric station at Iterlaa north of Paamiut were started in 1980. In 1982 the environmental consequences of the establishment of a hydroelectric station in the area were examined by Greenland Fisheries Research and Environmental Studies. During 1983 and 1984 master plans were worked out for a transmission plant and a hydroelectric station, respectively. In 1985 a run-off model was set up for the hydrological catchment area, and as a provisional dimensioning basis a model simulation of the run-off in the period 1959-1984 was carried out. Furthermore an evaluation has been made of the likelihood of the reservoir capacity being exceeded, or not sufficiently utilized. This report deals with the engineering-geological and construction-technical studies performed in 1984 and 1985. Some earlier studies of reservoir capacities and of the possibility of transporting water from the eastern catchment area have likewise been included. Together with earlier reports of preliminary studies this report describes the construction-technical basis of the proposed project. The studies have comprised a general engineering-geological evaluation of the area as well as detailed studies of various locations of hydroelectric stations, the possibility of establishing reservoirs and of transferring melt water from the eastern catchment area. With reference to an evaluation of the navigation conditions in the fiord, the innermost part of the fiord has been sounded, and water level observations as well as a single measurement of currents have been made. The rock's suitability for being drilled in and dynamited has been examined. Temperature measurements have been made of lake "306" and of lake "318", and an analysis has been made of the chemical composition of the water in lake "306", in preparation for choosing the materials for the turbines.

36613 **(NEI-DK—25) Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Supplement.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Dec 1986. 173p. (In Danish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752370.

The preliminary hydrological and construction-technical studies for a hydroelectric station at Iterlaa north of Paamiut were started in 1980. In 1982 the environmental consequences of the establishment of a hydroelectric station in the area were examined by Greenland Fisheries Research and Environmental Studies. During 1983 and 1984 master plans were worked out for a transmission plant and a hydroelectric station, respectively. In 1985 a run-off model was set up for the hydrological catchment area, and as a provisional dimensioning basis a model simulation of the run-off in the period 1959-1984 was carried out. Furthermore an evaluation has been made of the likelihood of the reservoir capacity being exceeded, or not sufficiently utilized. This report deals with the engineering-geological and construction-technical studies performed in 1984 and 1985. Some earlier studies of reservoir capacities and of the possibility of transporting water from the eastern catchment area have likewise been included. Together with earlier reports of preliminary studies this report describes the construction-technical basis of the proposed project. The studies have comprised a general engineering-geological evaluation of the area as well as detailed studies of various locations of hydroelectric stations, the possibility of establishing reservoirs and of transferring melt water from the eastern catchment area. With reference to an evaluation of the navigation conditions in the fiord, the innermost part of the fiord has been sounded, and water level observations as well as a single measurement of currents have been made. The rock's suitability for being drilled in and dynamited has been examined. Temperature measurements have been made of lake "306" and of lake "318", and an analysis has been made of the chemical composition of the water in lake "306", in preparation for choosing the materials for the turbines.

36614 **(NEI-DK—29) Preliminary investigation hydroelectric power 1984. Power plant technology. Part report 1, Iterlaa Paamiut/Frederikshaab.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). 1986. 106p. (In Danish). NTIS (US Sales Only), PC A06. File Number DE87752475.

The main rock formation in the region is gueiss. Alternative 1A constists in construction in a bowl formed amphibolite region. Lake "306" gives some advantages, but thorough investigation of tunnel conditions has to be carried on. Alternative ID is reasonable for water intake, the tunnel would pass an amphibolite belt. Lake "53" can be used for intake tunnel. Expenditure calculations are based on the costs of securing work. Temperature measurements and coldtechnolocal evaluations have to be accomplished (EG).

## 1303 Plant Design And Operation

36615 **(DOE/RA/23209—1) Small-scale hydroelectric demonstration project: Reactivation of the Elk Rapids Hydroelectric Facility: Final operation and maintenance report.** Miller, R.G. (Antrim, County of, Bellaire, MI (USA)). Mar 1987. Contract FC07-79RA23209. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010943.

Information related to the reactivation of the Elk River Hydroelectric Power facility is reported. This report includes a history of the power plant, pertinent cost data, emergency action plans, inspections and testing, warranty work, operating problems, project data, monthly production data, and monthly operating and maintenance costs. 15 figs., 3 tabs.

## 1306 Environmental Aspects

*REFER ALSO TO CITATION(S) 37766*

36616 (CONF-8608141—, pp 234-242) **White alder growth and development: the effect of small hydroelectric projects in the Sierra Nevada of California.** Doyle, T.W. (Oak Ridge National Lab., TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A denderoecological study of white alder, Alnus rhombifolia, growth and development was implemented to evaluate the effect of diverted streamflow on riparian vegetation by small hydroelectric projects in the western Sierra Nevada of California. The study was designed to determine whether white alder trees along dewatered stream reaches incurred greater moisture stress and/or growth decline due to streamflow reduction as compared with individuals along unaffected or normal stream reaches. A total of 27 trees were cored, wherein 13 included trees along dewatered stream sections and the remaining from unaffected stream stretches. Ring width was measured for every growth year and used in conjunction with diameter readings to calculate yearly basal area increment. Results showed no significant reduction or decline in either radial growth or basal area increment between the pre-diversion (normal) decade and post-diversion (dry) periods. Age group analyses indicated that no significant difference in growth rate existed between the dewatered and unaffected groups of any age class. In most cases, growth rates of trees under dewatered conditions proved slightly greater than their counterparts persisting under normal stream activity. These findings suggest that other factors

(i.e., rooting substrate and depth, competition) likely play a greater role in limiting white alder growth than does water availability as dictated by streamflow. 2 references, 4 tables.

**36617 (EPRI-EA—5202) Mechanisms of compensatory response of fish populations: Workshop proceedings.** Shriner, C.R. (Otto (R.G.) and Associates, Key West, FL (USA); Science Applications International Corp., Los Altos, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 378p. (CONF-8401120—; CONF-8408220—; CONF-8502155—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920470.

From Workshop on mechanisms of compensatory response of fish populations; Palo Alto, CA, USA (1 Jan 1984).

This report is a compendium of the formal presentations made at the three working meetings. It includes a series of seven "perspective papers" prepared by academic consultants and relating to the conceptual aspects of the planning process. This series is followed by a discussion of potential project applications to Industry needs. Finally, there is a series of papers on the recent attempts of some utilities to develop fish hatchery/stocking programs as a mitigative solution to the perceived problem of mortalities at power plant cooling systems. Separate abstracts have been prepared for individual papers.

**36618 (NEI-DK—22) Reindeer investigations prior to the prospective hydroelectric power project Kangerluarsunnguaq/Buksefjord Nuuk/Godthaab 1984-1985.** (Groenlands Fiskeriog Miljoeundersoegelser, Copenhagen (Denmark)). Dec 1986. 80p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752367.

This report contains the final results of investigations concerning the caribou herd south of Ameralik fjord in the period 1982-1985. The purpose of the investigations was to get a background knowledge for evaluating the effects of the proposed hydropower project at Kangerluarsunnguaq/Buksefjord. The herd was estimated to number 2000-2500 individuals in November 1985 and seemed to be slightly increasing. During the investigations the proportion of younger individuals has increased. It is concluded that the herd most years is "limited" by snow conditions making a large part of the winter food unavailable. The hydropower project might influence the caribou during calving through construction activities. Furthermore, the transmission line could be expected to influence the use of different areas at different seasons, but it is not expected to exclude the animals from tho coastal areas. A suitable planning of construction activities in relation to season could relieve the effects. 24 refs.

# 14 SOLAR ENERGY

*REFER ALSO TO CITATION(S) 37000*

**36619 (EUR—9374) Solar energy: European research and development. Contractors' catalogue 1984.** Palz, W. (ed.). (Commission of the European Communities, Luxembourg). 1985. 339p. Commission of the European Communities, Luxemburg. File Number DE87751782.

This catalogue contains two-page summaries of the results obtained in the contracts on solar energy R and D, i.e.: solar radiation data, solar heating, the solar tower plant Eurelios, photovoltaic power generation, which were concluded between the Commission of the European Communities, Directorate-General (XII) for Science, Research and Development, Brussels, and a number of public and private research institutions in the European Community. Reporting period: 1979-83, as a rule. Programme frame: The programme and its budget were proposed by the Commission and adopted by the Council of Ministers of 11 September 1979. The programme duration was 4 years. Programme budget: Approx. 32.3 million ECU in total of which: solar radiation data: 2 million ECU, solar heating: 10.6 million ECU, Eurelios: 3.1 million ECU, photovoltaic power generation: 16.6 million ECU. Management: Contractors were selected mainly through requests for proposals. Contracts were concluded and managed by the Commission's staff in Brussels.

## 1403 Economics

*REFER ALSO TO CITATION(S) 36661, 36662*

## 1405 Solar Energy Conversion

*REFER ALSO TO CITATION(S) 36576, 36578, 36585, 36586, 36587, 36588, 36590, 36591, 36596, 36601, 36605, 36608, 36647, 36651, 37008, 37150, 37336, 37406, 37435, 37862*

**36620 (AD-A—179491/6/XAB) Graded-bandgap solar cells. Annual report, 1 September 1985-31 August 1986.** Olsen, L.C. (Joint Center for Graduate Study, Richland, WA (USA)). 1 Sep 1984. 30p. NTIS, PC A03/MF A01.

Graded-bandgap solar cells were investigated that have a structure consisting of an N-type graded emitter and a base region with a constant bandgap. The emitter bandgap was 2.1 eV at the front surface and then graded to 1.74 eV at the N/P homojunction based on a 1.74 eV bandgap. The aluminum gallium arsenide homojunction had a maximum value for internal photoresponse of 20% while the graded bandgap cell exhibited a peak value of 80%. Analyses of photoresponse data indicates the aluminum gallium arsenide homojunctions are characterized by minority carrier diffusion lengths of only .03 micrometers in the emitter and 0.1 micrometers in the base. Thus, the effective field resulting from the graded emitter in the graded-bandgap cell is necessary for an adequate photoresponse. Investigations of heteroface gallium arsenide solar cells continued with the purpose of building a data base for processing technology and characterization techniques. GaAs solar cells were fabricated with efficiencies over 17% using a P/N homojunction structure and AlGaAs heteroface. Electro-optical characterization of GaAs cells has resulted in improved understanding of minority-carrier properties, surface recombination velocity and current-loss mechanisms.

**36621 (BMFT-FB-T—86-136) Biomass production of problematic sites by generatively and vegetatively propagated high-yield-progenies of fast growing tree species. Final report.** Rau, H.M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770172.

The necessity of producing renewable raw material has only at present apparently lessened. In the long run, nevertheless, timer production rather has to be increased even as far as thin-wood production is concerned. Would it be possible to use for this purposes also problematic forest sites, which have been extensively utilized before. An inquiry should clarify to what extent in the German Federal Republic suitable sites to this purpose are available. Several tests have been made to study growth potential and resistance of several hundred aspen, grey poplar and birch progenies. It was estimated that approximately 2% of the total forest area in Germany could theoretically be utilized in the way described by the project. Progenies of selected or even by breeding improved aspen, grey poplars and birches can bring around a higher production than normally available material. The results of the project point out a possibility to increase the German timber production in an ecological efficient manner and without need of additional afforestation area. With 70 refs., 34 tabs., 56 figs.

**36622 (CONF-870497—2) Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules.** Wasielewski, M.R.; Johnson, D.G.; Svec, W.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02. File Number DE87011412.

From NATO workshop on photoinduced charge separation and energy migration in supramolecular species; Capri, Italy (5 Apr 1987).

A series of fixed distance chlorophyll-quinone donor-acceptor molecules have been prepared. The donor consists of either methyl pyropheophorbide a or methyl pyrochlorophyllide a, while the acceptor is either benzoquinone or naphthoquinone. The acceptors are fused to a triptycene spacer group, which in turn is attached to the donors at their vinyl groups. Picosecond transient ab-

sorption measurements have been used to identify electron transfer from the lowest excited singlet state of the donor to the acceptor as the mechanism of fluorescence quenching in these molecules. The charge separation rate constants increase from 2 x $10^{10}$ $s^{-1}$ to 4 x $10^{11}$ $s^{-1}$ as the free energy of charge separation increases, while the radical pair recombination rate constants decrease from 1.2 x $10^{11}$ $s^{-1}$ to 2 x $10^{9}$ $s^{-1}$ as the free energy of recombination increases. The resulting total reorganization energy $\lambda = 0.9$ eV.

36623 **(CONF-870666—1) Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules.** Wasielewski, M.R.; Johnson, D.G.; Svec, W.A. (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011442.

From 11. DOE solar photochemistry research conference; Tahoe City, CA, USA (7 Jun 1987).

The primary events of photosynthesis are a series of rapid, unidirectional electron transfer events between donors and acceptors that are positioned in the reaction center protein at precise spatial orientations and distances relative to one another. Recent work suggests that electron transfer rates depend on distance and free energy of reaction in porphyrin-quinone models in which the distance and orientation of the donor relative to the acceptor is highly restricted. Spacer molecules were developed which were used to link chlorophyll donors with either chlorophyll or quinone acceptors to produce models in which the donor-acceptor distance is well-defined. Recent theoretical studies and photochemical hole-burning experiments have suggested that the actual primary event of photosynthesis is the production of an intramolecular charge transfer state involving the two bacteriochlorophyll molecules of the special pair dimer. This possibility was explored with symmetric, fixed distance chlorophyll dimer. The chlorophyll macrocycles share a common vinyl group at the 2-position. This linkage serves to increase the degree of electronic coupling between the macrocycles. This dimer exhibits a remarkable decrease in fluorescence quantum yield as the dielectric constant of the medium in which it is dissolved increases. This decrease is accompanied by a proportional decrease in the lowest excited singlet state lifetime as measured by picosecond fluorescence and absorption. 11 refs., 2 figs.

36624 **(DOE/ER/02570—11) Investigation of the triplet state of chlorophylls: Final report, May 1, 1975 through April 30, 1987.** Clarke, R.H. (Boston Univ., MA (USA). Dept. of Chemistry). 1 Jun 1987. Contract AC02-76ER02570. 10p. (COO—2570-11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012074.

Our research program over the past twelve year period has utilized the triplet state of chlorophyll as a (nondestructive) probe into the structural and dynamical nature of the photosynthetic unit. Using primarily zero-field optically detected magnetic resonance spectroscopy, supplemented by resonance raman spectroscopy, we have examined the chlorophyll molecule for a range of environments in both in vivo systems and in model chlorophyll units in vitro. Our research effort has focused on chlorophyll in the presence of simple organic ligands, in lipid bilayer vesicles, in synthetically reconstituted protein, and on the surface of metal and nonmetal substrates. Aim of the research was to detail the physical features and interactions of the photosynthetic pigment systems through examination of pigment subunits of the photosynthetic apparatus and model systems which represent them.

36625 **(DOE/ER/12087—T4) [Mechanism of proton pumping by bacteriorhodopsin].** Ebrey, T.G. (Illinois Univ., Urbana (USA)). [1987]. Contract AC02-82ER12087. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012299.

Two methods were used to test the hypothesis that proteolysis of the C-terminal tail of bacteriorhodopsin affects the quantum efficiency of proton pumping. An apparent good correlation was found between the amount of the slowly decaying forms of the M intermediate and the number of protons pumped. This also suggests that the photocycle may contain M (fast) and M (slow) in different branches. Using artificial analogues of bacteriorhodopsin, the ring portion of the retinal was shown not to be an important factor in determining the photochemical and proton pumping properties of the artificial pigments, but that modification of the chain is. At least four double bonds along the chain are necessary for efficient proton pumping. The purple membrane normally contains several different cations tightly bound and it was shown that removal of these cations changes the color of the membrane from purple to blue. We proposed that cations acted by modulation of the surface potential and hence the local proton concentration near the membrane. A new intermediate was found in the bacteriorhodopsin photocycle, R. This new intermediate can explain several quite perplexing observations that have been made about the photocycle. The conformation of the retinal of the third rhodopsin-like pigment in Halobacteria, sensory rhodopsin, is all-trans and that light isomerizes the chromophore to the 13-cis conformation. 26 refs.

36626 **(DOE/ER/13532—1) Genetics and biochemistry of the Rhizobium meliloti acidic extracellular heteropolysaccharide and its role in nodulation: Annual report for the period 1 June 1986-31 May 1987.** Leigh, J.A. (Washington Univ., Seattle (USA)). 1987. Contract FG06-86ER13532. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011076.

This document briefly describes studies of the genetics and biochemistry of Rhizobium meliloti exopolysaccharides and their role in alfalfa root nodule formation. Previously the author demonstrated that a large set of mutants ($Exo^-$) of R. meliloti failed to secrete succinoglycan, an acidic exopolysaccharide of known structure. These mutations belonged to five different loci in the R. meliloti genome. All of the mutants shared the inability to enter alfalfa root nodules, providing strong correlative evidence that succinoglycan is involved in a certain phase in nodule development. In the past year, this research group characterized mutants that were previously designated "haloless" mutants. These mutants were thought to be unable to degrade the secreted polysaccharide into diffusible fragments that ordinarily form a halo of binding of a polysaccharide specific dye surrounding a colony of growth. The research team discovered a second acidic exopolysaccharide that is synthesized by certain mutant derivatives of our strain of R. meliloti. This polysaccharide appeared quite distinct from succinoglycan by NMR spectroscopy and appeared to replace succinoglycan in a Tn5-induced mutant called "halo-clearing", and in wild type strains containing a certain cosmid from the R. meliloti clone bank. 2 figs.

36627 **(DOE/ER/60381—2) Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987.** Gates, D.M.; Weber, J.A. (Michigan Univ., Ann Arbor (USA). Biological Station). 25 Jun 1987. Contract FG02-85ER60381. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011837.

Much of the research effort was in preparation for future experiments on the effects of nitrogen and water stresses on seedlings of Populus grandidentata and Quercus rubra. A major goal was to establish conditions for seed storage and for growth of plants. We established the upper limit for nitrogen fertilization for P. grandidentata, with preliminary data on Q. rubra. Poor seed production by Q. rubra in 1986 on property of the University of Michigan Biological Station limited work with this species. The authors collected data on photosynthetic response of leaves from plants grown at different nitrogen levels. These data provided confirmation of the growth responses observed, in that a rate of application one fifth of that recommended by the fertilizer manufacturer proved best. Experiments on the effects of air to leaf vapor pressure difference showed that VPD can affect photosynthesis in these plants. Theoretical studies, in the form of a computer program, incorporated energy budget equations, solar geometry, and a mechanistic model of photosynthesis into a program that allows prediction of leaf temperature, transpiration, and photosynthesis for leaves in any orientation at any time of the year at any point on the globe. 9 refs., 6 tabs.

36628 **(ETSU-B—1074) Algal biomass from farm waste. A pilot plant study.** Fallowfield, H.J.; Garrett, M.K. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 185p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Two culture vessels of 'Dortmund' raceway design, each of 2200 l capacity and 11.1 $m^2$ surface area, were constructed from marine plywood and glass reinforced plastic. Although Chlorella vulgaris 211/1e was inoculated into the separated flocculated pig slurry liquid phase, diluted one part in ten with water, a mixed algal flora developed in both batch and continuous cultures. Comparison of batch and continuous culture data indicated that continuous algal culture was the more efficient method of effluent treatment and biomass production. Short term algal productivities, were between 7.65 and 32.9 g DM $m^{-2} d^{-1}$ at retention times of about 4.5 days. A high degree of effluent treatment accompanied these high algal productivities. The $BOD_5$ reduction was of the order of 98%.

**36629 (EUR—9864) Continuous production of photovoltaic silicon ribbons by the new pendant drop growth (PDG) method.** Ricard, J.; Duffar, T. (Commission of the European Communities, Luxembourg). 1985. 126p. NTIS (US Sales Only), PC A07. File Number DE87751792.

In this work major aspects of the new crystallization process "Pendant Drop Growth" (PDG) method for crystalline silicon ribbonlike strips have been investigated. Apparatus and procedure were significantly improved and theoretical considerations led to a stable process as well as the possibility of manufacturing strips thinner than the lip thickness. The study of materials provided an ideal crucible, which is made of graphite with a specific gravity of at least 1.8 and is internally lined with SiC or pyrocarbon. The concible powder feeding system involving a vibrating bowl has also been markedly improved. A constant rate of output within +- 1.5% is obtained between 1 and 100 g/hr. The response of the concible to a temperature adjustment is immediate. Ribbons up to 500 mm long and 50 mm wide have been manufactured at an extrusion rate of as much as 90 cm/hr. Actual cost estimates showed that ribbons could be produced at less than 500 FF/m/sup 2/. Subsequent research has to be carried out in the following areas: reduction of thickness, automation, study and control of ribbon cooling, deduction of drawing lip external wetting.

**36630 (EUR—9955) Quality and quantity of latex which can be produced from natural vegetation in Greece.** Margaris, N.S.; Vokou, D.; Diamantopoulos, J. (Commission of the European Communities, Luxembourg). 1985. 37p. Commission of the European Communities, Luxembourg. File Number DE87752299.

Euphorbiaceae is one of the major latex producing families very promising in terms of exploitation as energy sources. Research in the Greek areas proved that Euphorbia species are very numerous with high contribution in biomass terms in many of them. Provided are data concerning growth characteristics of E. dendroides and E. acanthothamnos to answer the question of the feasibility of harvesting. E. helioscopia is proved to be a very promising species with many ecotypes. Its occurrence and extremely increased growth in olive, almonds, and pear plantations makes it a very important species needing further research to evaluate the possibility of combined cultivation with the above mentioned trees. It is estimated the oil production that such plantations may yield.

**36631 (NP—7770120) Methane production from lactose via defined mixed cultures of bacteria.** Schug, A. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 16 Jan 1986. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770120.

The conversion of lactose into CH/sub 4/ and CO/sub 2/ was investigated in two systems of defined mixed cultures, as well as the growth of the bacteria in pure cultures. The growth conditions for fast and complete acetate conversion were determined for M. barkeri. In the chemostat mixed culture of L. plantarum, A. woodii, and M. barkeri, stable flow equilibria were reached at D=0.27 and 0.37 d/sup -1/; in this condition, about 90% of 35 mM lactose was converted into CH/sub 4/ and CO/sub 2/.

**36632 (ORNL—6369) Herbaceous Energy Corps Program: Annual progress report for FY 1986.** Cushman, J.H.; Turhollow, A.F.; Johnston, J.W. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011965.

This report describes the activities and accomplishments of the Herbaceous Energy Crops Program (HECP) for the year ending September 30, 1986. HECP is devoted to research on the development of terrestrial, nonwoody plant species for use as energy feedstocks. HECP emphasizes lignocellulosic forage crops. In FY 1986 screening and selection trials continued on 25 species of perennial and annual grasses and legumes in five projects in the Southeast and the Midwest-Lake States regions. Research also continued on the development of winter rapeseed as a diesel-fuel substitute. Activities in FY 1986 included genetic crosses and selections to incorporate atrazine resistance, development of Canola-quality winter rapeseed for the Southeast, and development of dwarf varieties. Production practices for double-cropped winter rapeseed in the Southeast were also examined. Exploratory research efforts in FY 1986 included the physiology and biochemistry of hydrocarbon production in latex-bearing plants, the productivity of cattail stands under sustained harvesting, the development of tissue culture techniques for hard-to-culture sorghum genotypes, and the start of a study to measure sustained productivity of old-field successional vegetation. Environmental and economic analyses in FY 1986 included studies on the uses of wetlands and wet soils, the use of lignocellulosic crops as an alcohol feedstock, the potential of direct combustion of lignocellulosic crops, and existing oilseed extraction facilities. 6 refs., 12 figs., 15 tabs.

**36633 (PB—87-185260/XAB) Short-rotation harvester/chipper.** Keville, B.J.; Devenish, E.J. (Commission of the European Communities, Luxembourg). 1985. 22p. (EUR—9997-EN). NTIS, PC PC E03/MF E03.

Customers in the European Community countries should apply to the Office for Official Publications of the European Communities, B.P. 2985, Luxembourg.

The objective of the project was to design, build and test a harvesting system for short-rotation forestry. The harvesting machine was specified to cut and process a wide range of trees of various types and sizes, with maximum stem diameters not exceeding 10 cm. It should be capable of traversing different types of terrain including peatlands and sloping ground. The machine should be flexible, mobile, and should leave the plantation in a suitable condition to facilitate coppicing and regrowth of the cut stumps, while at the same time collecting all grown material without waste.

**36634 (SERI/STR—211-3127) Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986.** (Poly Solar, Inc., Garland, TX (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001168.

This research investigated the deposition of $CuInS_2$ films to determine the feasibility of using $CuInS_2$ for high-efficiency, thin-film solar cells. Two techniques were investigated for depositing p-$CuInS_2$ films on foreign substrates: (1) the close-spaced chemical vapor transport (CSCVT) technique; and (2) the deposition of Cu-In films by the thermal reduction of Cu and In compounds or by electro-deposition, followed by sulfurization. The photoresponse of CSCVT $CuInS_2$ films was poor, possibly due to stoichiometry, defects, or impurities. The deposition of Cu-In alloy films on W/$Al_2O_3$ and Mo/glass substrates was carried out by thermal reduction of a mixture of $Cu(NO_3)_2$ and $In(NO_3)_2$. However, relatively high temperatures were required, due to the stability of $In_2O_3$. The photovoltaic characteristics of $CuInS_2$ films prepared from electroplated Cu-In were similar to those from CSCVT; the highest open-circuit voltage and short-circuit current density were 0.35 V and 3 mA/$Cm^2$. The photoresponse of $CuInS_2$ films from chemically deposited Cu-In alloy are considerably inferior.

**36635 (SERI/STR—211-3148) Evaluation of local strain fields at [001] twist boundaries in silicon with transmission electron microscope diffraction: Final subcontract report.** Sullivan, T.; Ast, D.G. (Cornell Univ., Ithaca, NY (USA)). Apr 1987. Contract AC02-83CH10093. 227p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87001173.

This report describes work done to evaluate the local strain fields at [001] twist boundaries in silicon by means of transmission electron microscope diffraction studies. The research focused on sil-

icon solar cells fabricated from polycrystalline materials. The intent was to investigate the way in which the electrical activity at grain boundaries affects the performance of the solar cell, with a view to ultimately increasing the stability of this semiconductor material.

36636 **(SERI/TR—211-3052) High-rate deposition of hydrogenated amorphous silicon films and devices.** Luft, W. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001165.

This report summarizes the status of high-rate deposition technologies associated with amorphous silicon thin films for photovoltaic applications. The report lists (1) deposition rates for a-Si:H films according to source and method and (2) efficiencies and other parameters of a-Si:H solar cells. Two main deposition source materials, silane and disilane, are discussed, as well as effects of boron doping. The effects of various deposition parameters on film characteristics and on deposition rate are presented, as well as the effects of annealing on high-deposition-rate films. Light-induced effects are also discussed. Finally, progress and problems in this field of study are summarized.

36637 **(SNIAS—59-CA/CG) Concentration principle applied to spaceborne solar arrays. AGORA mission: studies synthesis.** Laget, R. (Societe Nationale Industrielle Aerospatiale, Cannes (France)). Jan 1986. 44p. (ESA-CR(P)—2291-VOL-2; ETN—87-99483). NTIS, PC A03/MF A01.

Studies that led to selection of the distributed 25 kW SARA LOUVRE concept for the solar cell generator to be flown on the AGORA asteroid mission, and the major characteristics of such a spaceborne solar array are summarized. In the SARA LOUVRE concept, a parabolic cross section reflector concentrates incident light over the rear face of the identical, preceding reflector dish. The whole set of reflectors is pivotally commanded, thus compensating the effects of depointing. Geometric concentration factor is 10. End of life power level at 2.5 AU is 4.5 kW.

36638 **(STEV-EO—87-2) Fuels from agricultural crops. Production estimates, cost of raw products and value of by-products.** Johnsson, B. (Statens Energiverk, Stockholm (Sweden)). 1986. 133p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752402.

In the present report of the project great emphasis is placed on the assessment of the possible production of fuel crops on arable land, the raw product costs required by growing and handling these crops, and the possible utilization and value of feed by-products of the production of ethanol and vegetable oils. The possibilities to achieve improvements in the growing and handling of the crops and thereby in the long run to decrease the cost of the raw material, are also dicussed. (G.B.).

36639 **(STEV-EO—87-3) Chipping, transport and firing of energy forest wood. Practical tests during the winter of 1985/1986.** Stridsberg, S. (Statens Energiverk, Stockholm (Sweden)). Nov 1986. 53p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752403.

The report is a first part on practical tests accomplished at the SLU plantations on Malmoen in Koeping and those of Sydkraft at Boerringe and Sturup in the southern parts of Sweden. The first one has a harvest of 45 tons of dry material per ha and the latter about 10 tons per ha. In spite of the different materials the results has proved rather representative. The handling of the wood in connection with the harvest strongly depends on local conditions. Our tests are carried out under very favourable conditions with ground frost and no snow. In some cases we have been able to make the chipping on the fields. The piling can be done with a tractor with usual or modified grapple. The tests have shown a cost of 10-15 SEK/MWh for this handling. The piles are very bulky and take up a lot of space, about 200 m/sp2/ per ha. The storing is necessary in most cases in order to get enough capacity in the chipping or loading. Tests with transport of loose wood on special three trucks show high costs, 20-30 SEK per MWh at 50-60 km distance. Compaction or bundling will be needed to decrease them. At first the chipping was considered to cause trouble. But our tests have given as result that energy forest material can be chipped almost with the same capacity as other wood assortment with steam form. The cost of chipping could be decreased to 20-25 SEK/MWh. The transport of chips has been carried out with standard carriages, containers or trucks. If chipping is done from piles at the field, containers will be the normal alternative, which is unfortunately the most expensive transport way. The combustion has been tested in some different furnaces, usually feed by stoker from below. Green chips have a rather high moisture content, 50-55 percent in 2-3 years stands. In general our tests confirm that available technique for handling, disintegrating, transport and burning will do even for energy forest material.

36640 **(UCLA—34P278-61) Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987.** El-Sayed, M.A. (California Univ., Los Angeles (USA). Dept. of Chemistry and Biochemistry). 1987. Contract AS03-78ER70278. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012178.

Research was carried out on the changes in the efficiency of the deprotonation process of the protonated Schiff base (PSB) and tyrosine during the photocycle of bacteriorhodopsin (bR) upon adding salts, changing the pH, removing metal cations and then regenerating purple bR by adding different types of cations. An important observation was that the amplitude of the slow forming component of $M_{412}$ (resulting from deprotonating the PSB) correlates with the amount of tyrosinate formed during the cycle. This supports our previous proposal that their formation results from the interaction of a cation or surface charge with an electrostatic electric field as a result of protein conformation changes. 11 refs.

36641 **Floating emitter solar cell.** Urbana, C.S.; Cheng, L.J. (to National Aeronautics and Space Administration, Washington, DC). US Patent 4,665,277. 12 May 1987. Filed date 11 Mar 1986. vp.

A solar cell is described comprising a semiconductor body of one conductivity type having parallel front and back surfaces. Floating emitter sections of opposite conductivity type form a p-n junction in the semiconductor body at the front, front sections in the semiconductor body at the front surface between adjacent ones of the floating emitter sections. The front sections separate from the floating emitter sections, and a back surface layer, each of the front sections and the back surface layer are of opposite conductivity type to each other. One is of the same conductivity type as the floating emitter sections to function as a collector for the floating emitter sections, and the other is of the same conductivity type as the semiconductor body to function as a contact section to the semiconductor body. The semiconductor body functions as a common base for the floating emitter sections.

36642 **Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition.** Yuan, R.K.; Peramunage, D.; Tomkiewicz, M. (Dept. of Physics, Brooklyn College of City Univ. of New York, Brooklyn, NY 11210). *Journal of the Electrochemical Society;* **134**: No. 4, 886-890(Apr 1987).

The authors present electrolyte electroreflectance and impedance studies of poly (3-methyl thiophene) in contact with an aqueous solution of methyl viologen. When the doping level of the polymer is reduced from its "as grown" value a new structure, at 1.7 eV, appears in the electroreflectance spectra which corresponds to the anticipated optical transitions due to the polaron gap states. The polaron spectra are absent in the fully doped and the neutral, "undoped," polymer. The polaron spectra have been monitored as a function of the electrode potential. The electroreflectance results are correlated with impedance measurements and with the photoelectrochemical spectral response of the film as a function of the doping level.

36643 **Spectral mismatch correction for GaAs solar cells with varying junction depths.** Emery, K.A.; Osterwald, C.R.; Aharoni, H. (Solar Energy Research Inst., Golden, CO, USA; Ben-Gurion Univ. of the Negev, Beersheba, Israel). *Solid-State Electronics;* **30**: No. 2, 213-215(Feb 1987).

This study experimentally demonstrates that large errors (25%) in solar cell current measurements can occur even if a prop-

erly calibrated reference cell of the same material system is used to set the intensity of the light source. The spectral mismatch correction procedure allows the accurate (2%) measurement of the illumination I-V characteristics. This is done with respect to standard test conditions defined by the temperature, intensity and reference spectrum. The results are independent of the light source spectral irradiance, or reference cell spectral response.

36644 **Progress in photovoltaic concentrator research.** Arvizu, D.E. (Sandia National Labs., Albuquerque, NM). pp 391-401 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper reviews the recent progress in photovoltaic concentrator research. In the past 18 months, several exciting new developments have been reported. Record efficiency concentrator silicon cells have been reported at Stanford University, with 28% efficient high resistivity cells, and at the University of New South Wales, with near 25% efficient low resistivity cells. Both groups also report record 22% one-sun efficiencies for these cells. Compound semiconductor cells have also made advances. Research on multijunction devices has led to a mechanically stacked concentrator cell with near 27% efficiency. Module improvements in commercial designs have taken the form of reduced cost and better component reliability.

## 1406 Photovoltaic Power Systems

36645 **(ENEA-RT/FARE—84-4) Delphos project - Wind actions on a parallel-rope tensio-structure for photovoltaic systems.** Beretta, A.; Cheli, U.; Diana, G.; Falco, M. (ENEA, Rome (Italy)). Apr 1984. 76p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752628.

Among new concepts of support structures for large size flat-plate photovoltaic systems, the parallel-rope tensio-structure is characterised by an extremely low weight-to-surface ratio. This feature, economically interesting mainly for application in remote areas, makes this structure particularly sensitive to the wind action. Therefore a theoretical and experimental analysis of static and dynamic behaviour of the tensio-structure under the effect of the wind has been carried out. It has also been verified eventual instability conditions due to the not uniform aerodynamic field. Wind tunnel tests have been performed using an analytical model based on finite elements method. Outcomes seem to exclude that instability phenomena may occur, subject a suitable stabilization structure of ropes being adopted; therefore the validity of the concept has been confirmed.

36646 **(EPRI-AP—5220) Electrical behavior of wind power stations: Final report.** Zaininger, H.W. (Zaininger Engineering Co., San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 93p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920460.

Coincident electrical performance of existing large MW-scale wind power stations at various levels of aggregation is useful information to help in establishing technology requirements of future utility grade wind power stations. The purpose of this project was to instrument and collect electrical performance data at several wind power stations at different locations in the United States, perform data reduction, and present electrical performance results on a generic basis. This report presents electrical performance results for wind power stations installed at an Altamont Pass Site, an East Coast Site, and at several sites in the Tehachapi Mountains.

36647 **(SAND—86-7036-Vol.1) Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1.** Castle, J.A. (Hughes Aircraft Co., Long Beach, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. 407p. NTIS, PC A18/MF A01. File Number DE87011607.

This report addresses the optimization of utility-sized, tracking flat-plate photovoltaic power systems. Structures optimized were one single-axis and one dual-axis tracking system using currently available system designs as baseline engineering reference points. Passive thermal-hydraulic tracking drive systems were evaluated and Freon-hydraulic units were found to be cost-effective in single-axis tracking. Building block configurations ranging in size from 35 kW to 5 MW were established using the optimized single- and dual-axis tracking structures, and their reliability and availability were analyzed. A 1-MW single-axis building block design was selected to develop engineering plans for a 100-MW PV power plant designed to operate unattended. Eleven-percent efficient PV panels at $\$220/m^2$ were used in the study, and single-axis, flat-plate tracking systems were found to be significantly more cost-effective than dual-axis systems. A prototype tracking array was built and tested at Sandia, where cost and performance data supported lower economic projections for large PV tracking arrays.

36648 **(SAND—87-0804C) Water pumping: The solar alternative.** (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8705126—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009296.

From Invocating in development conference; New Orleans, LA, USA (1 May 1987).

This paper is based on a report that has been prepared to provide an introduction into understanding the characteristics, including economics, of photovoltaically powered water pumping systems. Although thousands of these systems exist worldwide, many potential users do not know how to decide whether or not photovoltaic pumping systems are an attractive option for them. This paper and the accompanying report provide current information on design options, feasibility assessment, and system procurement so that the reader can make an informed decision about water pumping systems, especially those powered with photovoltaics.

36649 **(SMUD-PV—2) SMUDPV2 quarterly performance report IV for the period January through March 1987.** Collier, D.E. (Sacramento Municipal Utility District, CA (USA)). Apr 1987. Contract FC03-82CE30701;FC03-83CE11968. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011266.

SMUDPV2 is a nominal 1 MW/sub AC/ photovoltaic (PV) power plant located adjacent to the Rancho Seco generating station, 30 miles southeast of Sacramento, California. The design and construction of PV2 was a joint effort between the Sacramento Municipal Utility District (SMUD) and the United States Department of Energy (DOE). It is the second phase of a multiphase PV power plant project with a planned generating capacity of 100 MW/sub AC/. SMUD's primary objective in this project is to install a PV power plant that will add economical energy generation capacity to their system. To this end, the data generated by the operation of PV2 will be used by SMUD to verify the value of PV to the rate payers of Sacramento, to assess the specific performance of the PV2 design, and to facilitate planning, design, and construction of future phases.

36650 **Lessons learned and issues raised at the Sky Harbor photovoltaic project.** Eckert, P. (Arizona Public Service Co., Phoenix, AZ). pp 418-423 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper discusses the operational experiences of the Sky Harbor photovoltaic project. The importance of Quality Assurance (QA) and how it has affected the Sky Harbor Project is stressed. Both electrical and mechanical problems, their solutions, and their impact on the project are covered in detail. Moisture related ground faults have contributed to many module failures and an array fire. Gearbox related problems have played a major role in the mechanical aspects at Sky Harbor since day one. The impact of an unreliable Power Conditioning Unit as it pertains to photovoltaic power plants is discussed.

36651 **Operational experience with grid-connected photovoltaic systems.** Atmaram, G.H. (Florida Solar Energy Center, Cape Canaveral, FL). pp 375-383 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

For the last six years, Florida Solar Energy Center (FSEC) has conducted research on the operational performance, reliability and grid-connection issues of photovoltaic systems. A number of grid-connected photovoltaic systems have been designed, installed, operated and tested at FSEC during this period. These include the Photovoltaic house, three residential prototype systems, a flexible test facility and four flat-plate tracking systems. This paper presents two year (July 1984 through June 1986) operational performance data on the three residential prototype systems, including the photovoltaic arrays and power conditioning subsystems. In addition to the performance data, the operational reliability of the arrays (modules), power conditioners and balance of system (BOS) components is discussed.

36652 **Some applications of recent R and D experiences in the sizing of stand-alone photovoltaic power systems.** Menicucci, D.F. (Sandia National Labs., Albuquerque, NM). pp 738-741 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Stand-alone photovoltaic (PV) power systems have become a cost-effective energy source for various applications. As the demand for stand-alone PV power systems grows, more importance is placed on improving system cost-effectiveness and reliability. Sandia National Laboratories is responding to this need through the development of detailed PV performance models which are being employed as the basis for simplified design methods. This paper outlines some of the most important conclusions from this work including the application of PVFORM, a computerized systems simulation model in optimizing a PV system configuration. Specific examples are presented and the use of the model is described with respect to determining the most cost-effective component configuration in a stand-alone PV system.

36653 **Designing photovoltaic systems.** Jones, G.J. (Sandia National Labs., Albuquerque, NM). pp 703-708 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Photovoltaic system design understanding has matured rapidly in the last decade. Initially the design process emphasized detailed modeling, load match, and on-site energy storage. This entire approach ended once the systems were allowed to operate interactively with the utility. Current design thinking emphasizes system energy cost in relation to utility avoided cost. This leads to a new logic that allows for much simplified design procedures. This paper reviews these procedures for the two types of grid-connected photovoltaic systems and presents a brief discussion of balance-of-system options.

## 1407 Solar Thermal Power Systems

36654 **(CEA-CONF—8717) Vignola project.** Bacconnet, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Sep 1986. 18p. (In French). (CONF-8609270—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751773.

From Seminar on evaluation of the solar thermal program; Sophia Antipolis, France (16 Sep 1986).

After a recall of the various stages of the project, conception and construction of the solar thermal pilot plant of Vignola (France), the performances and the economical results obtained and also the decision to stop this program are presented.

36655 **(PNL-SA—14022) Performance issues in solar thermal energy transport systems.** Zimmerman, P.W. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 7p. (CONF-870307—22). NTIS, PC A02. File Number DE87011336.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Pacific Northwest Laboratory, sponsored by the US Department of Energy through Sandia National Laboratories, is performing an assessment of three solar thermal electricity generating concepts; central receivers, dishes, and troughs. Concepts are being studied over a range of system sizes 0.5 MWe to 100 MWe with solar multiples from 1.0 to 2.8. Central receiver systems using molten salt, sodium, and water-steam working fluids are studied. The dish system selected for study uses a kinematic Stirling engine at the focal point, and the trough system is based on Accurex designed collectors heating a heat transfer oil. Of the three concepts studied, the central receiver and trough systems utilize thermal transport systems. A thermal transport system is the piping and fluid required to transfer thermal energy between receiver, and storage and between storage and steam generator. The literature contains many transport system designs, most of which are optimized with regard to cost and performance. We used the parameters specified from the optimizations to design our systems and scale the designs over the 0.5 MWe to 100 MWe size range. From these designs, thermal losses and pump sizes are derived then combined in a system model to obtain total annual averaged efficiency as a function of plant field size. We found that central receiver transport efficiency improves with field size whereas trough transport efficiency degrades with field size. We found that overnight cooldown accounts for roughly 50% of the total thermal losses for all transport systems. Trough performance is substantially degraded because the receiver tubes are not drained which allows a large overnight heat loss. Trough transport performance was found to be sensitive to fluid velocity.

36656 **(SAND—86-2165) SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants.** Chiang, C.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011606.

The computer program SUNBURN simulates the annual performance of solar-only, solar-hybrid, and fuel-only electric power plants. SUNBURN calculates the levelized value of electricity generated by, and the levelized cost of, these plants. Central receiver solar technology is represented, with molten salt as the receiver coolant and thermal storage medium. For each hour of a year, the thermal energy use, or dispatch, strategy of SUNBURN maximizes the value of electricity by operating the turbine when the demand for electricity is greatest and by minimizing overflow of thermal storage. Fuel is burned to augment solar energy if the value of electricity generated by using fuel is greater than the cost of the fuel consumed. SUNBURN was used to determine the optimal power plant configuration, based on value-to-cost ratio, for dates of initial plant operation from 1990 to 1998. The turbine size for all plants was 80 MWe net. Before 1994, fuel-only was found to be the preferred plant configuration. After 1994, a solar-only plant was found to have the greatest value-to-cost ratio. A hybrid configuration was never found to be better than both fuel-only and solar-only configurations. The value of electricity was calculated as The Southern California Edison Company's avoided generation costs of electricity. These costs vary with time of day. Utility ownership of the power plants was assumed. The simulation was performed using weather data recorded in Barstow, California, in 1984.

36657 **(SAND—86-2823C) Liquid metal thermal electric converter.** Lukens, L.L.; Andraka, C.E.; Moreno, J.B.; Abbin, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 7p. (CONF-870804—8). NTIS, PC A02. File Number DE87010435.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Sandia National Laboratories is actively engaged in the evaluation and development of heat engine technologies applicable to dish electric systems. Our preliminary heat engine technology as-

sessment identified the Liquid Metal Thermal Electric Converter (LMTEC) concept as having the potential to meet the DOE's Solar Thermal Technology Program long term cost and performance goals with further engineering development. LMTEC work at Sandia has concentrated on three major areas; the conceptual design of a 25 kWe unit for mounting at the focus of a parabolic dish type solar collector, analytical modeling of the LMTEC to better understand its limitations and advantages, and the design, construction, and test of a single cell bench test module to validate analytical models, evaluate design concepts, and gain experience with materials.

36658 **(SAND—86-2828C) Reflux heat-pipe solar receiver for a Stirling dish-electric system.** Ziph, B.; Godett, T.M.; Diver, R.B. (Stirling Thermal Motors, Inc., Ann Arbor, MI (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-870804—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009289.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The feasibility of competitive, modular bulk electric power from the sun is enhanced by the use of a reflux heat-pipe receiver to combine a Stirling engine with a paraboloidal dish concentrator. This combination represents a potential improvement over previous successful demonstrations of Stirling dish-electric technology in terms of enhanced performance, lower cost, and longer life. In the reflux (i.e. gravity assisted) heat-pipe receiver, concentrated solar radiation causes liquid sodium to evaporate, the vapor flows to the Stirling engine heaters where it condenses on the heater tubes. The condensate is returned to and distributed over the receiver by gravity (refluxing) and by capillary forces in a wick lining the receiver. It is essentially an adaptation of sodium heat pipe technology to the peculiar requirements of concentrated solar flux and provides many potential advantages over conventional tube receiver technology. This paper describes the preliminary design of a reflux heat-pipe solar receiver to match the STM4-120 variable swashplate Stirling engine to a Test Bed Concentrator at Sandia National Laboratories Distributed Receiver Test Facility. Performance analysis and other design considerations are presented and discussed.

36659 **(SAND—87-8008) An analysis of power production performance for solar one, the 10 MWe Solar Thermal Central Receiver Pilot Plant.** Radosevich, L.G. (Sandia National Labs., Livermore, CA (USA)). Jun 1987. Contract AC04-76DR00789. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011696.

This report describes an analysis of power production performance for Solar One, the 10 MWe Solar Thermal Central Receiver Pilot Plant near Barstow, California. Solar One has been undergoing power production testing since August 1984. During this period plant performance indicators, such as capacity factor and system efficiency, have been studied to assess the capability of Solar One to supply electrical power. Solar One has shown an improvement in performance since power production testing began. Considerable increases in capacity factor and system efficiency were achieved. The factors contributing to these increases and approaches for achieving further increases are discussed.

36660 **System selection and life testing results of drain down and glycol closed loop active systems.** Avery, J.G. (Los Alamos National Lab., Los Alamos, NM). pp 324 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Real time corrosion data has been generated for fluid containing materials in active solar systems with: a) mildly corrosive water typical of that used in drainback systems, and b) degraded-uninhibited propylene glycol that represents the worst case in a closed loop system.

36661 **Cost drivers for solar thermal central receiver power plants.** Brown, D.R. (Pacific Northwest Lab., Richland, WA). pp 42-52 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Studies recently completed at the Pacific Northwest Laboratory have allowed an in-depth examination of costs for solar thermal central receiver power plants. Central receiver concepts were evaluated for plant power ratings ranging from 0.5 to 100 MWe, and plant capacity factors ranging from 0.25 to 0.60. The large number of plant configurations considered necessitated the development of cost estimating models. Cost models were developed for concentrator, receiver, transport, storage, energy conversion, balance of plant, and Q and M components. This paper presents a detailed discussion of costs for solar thermal central receiver power plants. Principal subcomponents and cost drivers are identified for each component.

36662 **Value/cost optimization of solar central receiver electric power plants.** Dirks, J.A.; Chiang, C.J. (Pacific Northwest Lab., Richland, WA). pp 35-41 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Typically, solar thermal power plants are designed with the objective of minimizing the levelized energy cost. However, to maximize the benefit of a solar plant, and hence, maximize the wealth of an investor or a utility, a solar plant should be designed and operated with the objective of maximizing the value to cost ratio. This paper describes a value and cost analysis of solar central receiver power plants using molten salt external receiver technology. These plants were assumed to operate within the service area of the Southern California Edison Company. The SOLERGY computer code was used to simulate the performance of the solar plants using 1984 weather data for Barstow, California.

36663 **A flux-on method for determining thermal losses from solar central receivers.** Boehm, R.; Nakhaie, H.; Bergan, N.E. (Univ. of Utah, Salt Lake City, UT). pp 494-499 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A method that allows an estimate of thermal losses during actual operation of a solar central receiver without requiring explicit information about the magnitude of the incident solar flux is described in this paper. In most central receiver evaluations, the flux incident on the receiver is not measured because instrumentation is complex and unreliable. Therefore, the conventional approach to thermal loss measurements has been flux-off loss tests. However, the need to measure losses of actual operating conditions has led to flux-on methods that do not require a direct measurement of incident flux. In the flux-on technique described here, the receiver is operated at three different flux levels, assuming constant receiver temperature. One evaluation of this technique, on the external Molten Salt Electric Experiment receiver at the Central Receiver Test Facility is discussed in this paper.

36664 **Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver.** Carli, G.; Narayanan, T.V.; Staed, T.P. (Foster Wheeler Corp., Livingston, NJ). pp 488-493 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper presents the results of the design and fabrication of low- and high-temperature absorber panels for a 5-MWt molten salt cavity test receiver. Included are a brief description of the test receiver, a detailed description of the panel configuration and fabri-

cation, and a discussion of the thermal/hydraulic and stress analysis.

36665 **An external molten salt solar central receiver test.** Bergan, N.E. (Sandia National Labs., Livermore, CA). pp 474-478 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The first external molten salt solar central receiver was tested as part of the Molten Salt Electric Experiment. The objective of the external test was to compare cavity and external performance. Test results showed that the thermal efficiency of the external receiver was slightly less than that of the cavity receiver. However, the external receiver was easier to start up, giving it an operational advantage. Convective losses were measured from the external receiver and compared to empirical correlations. Four demonstration tests were performed on the external receiver. A high flux text exposed the receiver to flux levels of 1 MW/m/sup 2/ compared to design point flux of 0.6 MW/m/sup 2/.

36666 **The Molten Salt Electric Experiment: A project overview.** Delameter, W.R. (Sandia National Labs., Livermore, CA). pp 468-473 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The Molten Salt Electric Experiment was the first full solar-to-electric central receiver system to use molten nitrate salt as a primary working fluid. The experiment was built and tested at the Central Receiver Test Facility in Albuquerque, New Mexico, between 1982 and 1985. The purpose of the project was to demonstrate the technical feasibility of a molten salt central receiver system. The Molten Salt Electric Experiment was operated through a year of successful testing; system performance was measured, operating procedures and an effective receiver control algorithm were developed, and personnel from participating electrical utilities and solar industries were trained to operate the system.

36667 **Experiments and analysis on the molten salt direct absorption receiver concept.** Bohn, M.S.; Wang, K.Y. (Solar Energy Research Institute, Golden, CO). pp 459-467 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper presents results of recent experiments on the Direct Absorption Receiver (DAR) concept using molten salt as the working fluid. These experiments were aimed at determining whether the DAR concept is technically feasible and were carried out at the Advanced Components Test Facility, Atlanta, Ga. Results are based on several days of operating with solar flux ranging up to 50 W/cm/sup 2/ and also on a numerical model that is capable of predicting the thermal performance of the DAR salt film. Issues relating to thermal efficiency, absorber-to-salt heat transfer, and salt film stability are addressed.

36668 **The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system.** Tyner, C.E.; Tracey, T.R. (Sandia National Labs., Albuquerque, NM). pp 350-355 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The Direct Absorption Receiver (DAR) concept was proposed in the mid 1970's as an alternative advanced receiver concept to simplify and decrease the cost of central receiver systems. Rather than flowing through tubes exposed to the concentrated solar flux, the heat-absorbing fluid ( a blackened molten nitrate salt) flows in a thin film down a basically flat, vertical panel and absorbs the flux directly. Potential advantages of the DAR include a substantially simplified design, improved thermal performance, increased reliability and operating life, and decreased operating costs. High flux capability also results in decreased receiver size and capital costs.

36669 **Terminal concentrators for solar central receiver applications.** Chuah, Y.K.; Anderson, J.V. (Solar Energy Research Institute, Golden, CO). pp 344-349 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A central solar receiver system is a high-temperature solar thermal system with many heliostat mirrors reflecting light energy onto a single receiver. Terminal concentrators are secondary reflectors that are mounted on the receivers to increase the concentration of light from the primary concentrators. The resulting reduction of the aperture of the receiver will also reduce the thermal losses. This study investigated the extent to which terminal concentrators could affect both the optical and thermal performance of a solar central receiver. The results demonstrate that adding a flat-plate terminal concentrator with a reflectance of 0.9 to a system optimized without a terminal concentrator could reduce the combined optical and thermal losses by about 15% and improve the overall performance by about 2%.

36670 **Systems analysis of the direct-absorption receiver.** Anderson, J.; Short, W.; Wendelin, T.; Weaver, N. (Solar Energy Research Institute, Golden, CO). pp 339-343 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The direct-absorption receiver (DAR) represents a fairly significant departure from conventional salt-in-tube receiver technology and appears to offer substantial promise for future generations of solar central receivers. The DAR concept involves absorbing the solar flux directly into a film of molten salt that flows in a thin film over a plate. Because the film absorbs most or all of the flux directly, the flux limits associated with tubular receivers can be relaxed substantially. This allows smaller and lighter receivers, which results in better thermal performance and lower capital costs. This paper describes the results of an effort to analyze the effects of these factors on system performance and energy cost.

36671 **Three freeze protection methods applied to a large solar energy system.** Kummer, J.P.; Duffie, J.A.; Beckman, W.A. (Univ. of Wisconsin-Madison, Madison, WI). pp 920-925 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The three most common types of freeze protection for solar energy systems using liquid flat plate collectors, are drain-back, recirculation, and dual fluid. Each freeze protection scheme was modeled using the computer simulation program TRNSYS. The models were based on the large solar energy system installed at the Indian Health Facility in Chinle, Arizona. Simulations were used to study control strategies and to predict the annual thermal energy performance of systems incorporating each of the freeze protection methods.

36672 **Analysis of solar thermal concepts for electricity generation.** Williams, T.A.; Brown, D.R.; Dirks, J.A.; Drost, M.K. (Pacific Northwest Lab., Richland, WA). pp 779-785 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper presents performance and cost projections for three of the primary solar thermal alternatives studied in the U.S.

Department of Energy Solar Thermal Program. The three solar thermal alternatives analyzed for electricity production included 1) a central receiver concept using a north-facing molten nitrate salt cavity receiver, 2) a glass-metal parabolic dish concept with a dish-mounted kinematic Stirling engine, and 3) a parabolic trough concept. The costs and performance are projected for the late 1990s; the projections are based on capabilities that could be achieved through further development using existing technology. Both the central receiver and dish concepts analyzed in this study appear to be attractive long-term power options for electric power applications. The central receiver concept achieved the lowest levelized energy cost, at a value of 60 mills/kwH for a 100 MWe plant at high capacity factors.

36673 **Effects of low velocity air flow over alumina-silica insulating boards in solar environments.** Maxwell, C.R.; Couch, W.A.; Mulholland, G.P. (Technadyne Engineering Consultants, Albuquerque, NM). pp 680-685 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Results are reported from an experiment designed to determine whether low velocity air flow over insulating boards can increase their survivability in severe solar environments. The experiment was conducted at the Flux Gage Calibration Station located at Sandia National Laboratories' Solar Thermal Test Facility. Preliminary results indicate that the useful life for these boards can be significantly increased by air flowing over the hot surface of the board.

36674 **Solar thermal central receiver power - A viable option for the 1990's.** Granichi, S. (Solar Thermal Technology Div., Dept. of Energy, Washington, DC). pp 7-10 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The last decade of research and development on solar thermal central receiver systems supported cooperatively by the Federal Government and Industry has resulted in the development of subsystems and components which offer potential economic competitiveness with fossil fuel plants for peaking and intermediate load applications by the mid-1990s. A key development is a new stressed membrane concept for solar concentrators that has the potential of reducing the cost of heliostats and parabolic dishes by more than 50% over the present glass/metal heliostat state-of-the-art. This is particularly significant because the cost of the concentrators typically accounts for up to one half the cost of the entire solar thermal system. There are two key parts to the concept: a lightweight structure and a silver steel or silvered polymer reflecting film.

36675 **Performance issues in solar thermal energy transport systems.** Zimmerman, P. (Pacific Northwest Labs., Richland, WA). pp 697-702 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC06-76RL01830.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Pacific Northwest Laboratory is performing an assessment of solar thermal electricity generating concepts. Thermal transport systems for central receiver and troughs are analyzed as part of the assessment. The authors found that central receiver transport performance improved with increasing field size up to about 100,000 m/sup 2/ beyond which performance is essentially constant. The estimated trough transport performance is nearly constant for optimized systems and shows some decrease for un-optimized designs. The estimated performance of troughs is significantly greater than the actual performance of experimental installations. Issues affecting thermal performance are explored. It was found that choice of expansion compensation is not very important for central receivers except for sodium cooled central receivers. Trough transport performance was found to be sensitive to type of expansion compensation and also sensitive to the number of trough modules in series.

36676 **The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system.** Weirick, L.J.; Greenholt, C.J. (Sandia National Labs., Albuquerque, NM). pp 676-679 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A number of thermochemical cycles have been proposed for energy transport. The one under investigation at Sandia National Laboratories Albuquerque involves converting a carbon dioxide/methane mixture to carbon monoxide and hydrogen during the endothermic reforming reaction, and then back again to carbon dioxide and methane during the exothermic methanation reaction. Carbon formation and deposition in either the reformer or the methanator is a serious concern. The authors performed simultaneous thermogravimetric and gas spectrometric analyses to measure carbon deposition rate and changing gas composition in the presence of material candidates for use in the reforming/methanation loop.

36677 **Design of the small community program (SCSE #2) at Molokai, Hawaii.** Bilodeau, E.A.; Borton, D.N.; Rogers, W.E.; Inall, E.K. (Power Kinetics, Inc., Troy, NY). pp 810-814 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Power Kinetics, Inc. (PKI) is building a solar power station to be installed on the island of Molokai, Hawaii under a contract with the U.S. Department of Energy. The station will consist of five modules to produce 50 kW each. These consist of a 306m/sup 2/ point focus collector with polar axis tracking, a ground mounted steam engine driving an induction generator via a cam clutch, an oil fired boiler and superheater, and a water cooled condenser. The steam system will produce 363 kgm of steam per hour at 6.89 MPa. The temperature at the exit of the solar receiver will be 280°C and at the outlet of the superheater, 450°C. The boiler can produce the steam when there is no sun.

## 1408 Ocean Energy Systems

36678 **Simultaneous production of desalinated water and power using a hybrid-cycle OTEC plant.** Panchal, C.B.; Bell, K.J. (Argonne National Lab., Argonne, IL 60439). *Journal of Solar Energy Engineering;* **109**: No. 2, 156-160(May 1987). Contract W-31-109-ENG-38.

A systems study for simultaneous production of desalinated water and electric power using the hybrid-cycle OTEC system was carried out. The hybrid cycle is a combination of open and closed-cycle OTEC systems. A 10 MWe shore-based hybrid-cycle OTEC plant is discussed and corresponding operating parameters are presented. Design and plant operating criteria for adjusting the ratio of water production to power generation are described and their effects on the total system were evaluated. The systems study showed technical advantages of the hybrid-cycle power system as compared to other leading OTEC systems for simultaneous production of desalinated water and electric power generation.

36679 **Open-cycle ocean thermal energy conversion-experimental program development.** Castellano, C.C.; Johnson, D.H. (U.S. Dept. of Energy, Washington, DC). pp 125-130 of Current practices and new technology in ocean engineering - 1987. Wolfe, G.K. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Open-cycle ocean thermal energy conversion (OC-OTEC) development was begun as a federal program at the U.S. Department of Energy (DOE) in the late 1970s. Beginning with research performed by the Westinghouse Corporation OC-OTEC, the development of OC-OTEC is reviewed and some of the significant elements involved in R and D for this technology are described. Sys-

tems analysis for this technology has permitted detailed experimentation of major components, development of performance criteria and the analytical trade-off of system/component level performance. Research efforts are phasing from analysis to experimental verification. Component and system level test objectives and performance goals have been established and the capabilities of major components are assessed and validated.

## 1409 Solar Thermal Utilization

*REFER ALSO TO CITATION(S) 37076*

36680 **(BFR-R—43-1986) Conditions for solar district heating. Market analysis.** Gransell, H.; Hedman, H.; Grynblat, J.; Johansson, B. (Swedish Council for Building Research, Stockholm). 1986. 99p. (In Swedish). NTIS (US Sales Only), PC A05. File Number DE87752394.

The aim of the project was to estimate the market of solar collectors, connected to existing and future district heating systems. Owing to accessible space, the potential is reduced from 5 TWh to 1.5 TWh. Due to complication with alternative fuels, cogeneration, waste utilization, heat pumps etc this market potential will become almost zero. In some very special cases there will be some profit e.g. for low temperature systems which cannot be converted to solid fuels and thus still use oil for base load. (G.B.).

36681 **(DOE/SF/15303—1) Analysis of the seasonal performance of hybrid desiccant cooling systems.** Sick, F. (Wisconsin Univ., Madison (USA). Solar Energy Lab.). Apr 1987. Contract FG03-84SF15303. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010502.

A simulation model for the liquid desiccant component of a hybrid system was developed. An analysis of experimental test data was conducted. The liquid desiccant component was examined and the sensitivity of its seasonal performance to changes in principal component variables was identified. Seasonal simulations were performed on different operation modes of a hybrid liquid desiccant cooling system. The results were analyzed in terms of estimated operational costs and compared to the equivalent cost estimation of a conventional cooling system. The study showed that the investigated liquid desiccant configuration usually will not lower the costs of operation. A suggestion of an improved system is made.

36682 **(DOE/SF/15303—2) A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing.** Pagnier, M. (Wisconsin Univ., Madison (USA). Solar Energy Lab.). Apr 1987. Contract FG03-84SF15303. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010501.

The importance of stratification to the performance of Solar Domestic Hot Water (SDHW) systems has been emphasized in the last several years. For a long time, the use of high collector flow rates (about 70 kg/hr-m$^2$) was thought to be the part of the optimum strategy for SDHW systems. Recent studies based on experiments and simulations have shown, however, that the performance of these systems may be improved significantly by reducing the collector flow rate to about 10 kg/hr-m$^2$. High flow rates permit higher collection efficiencies but prevent stratification in the storage tank. In addition to the gains in thermal performance due to improved stratification, a low flow strategy has other advantages such as a reduction in piping materials and parasitic power requirements. The preceding factors explain the increasing in designing SDHW systems to operate at low collector flow rates. Stratification can also be induced in the storage tank by the use of properly designed diffusers. The diffuser for the tank inlet flow is an important component since well designed diffusers prevent the momentum of the incoming fluid from destroying the stratification. Mixing in the storage tank is the main cause of the gains resulting from a decrease in the collector flow rate. A design method, based on the utilizability concept, has been developed to estimate the performance of SDHW Systems when there is no mixing in the tank. For this case, comparisons of the yearly solar fraction predicted by TRNSYS and by this new version of the anti $\theta$,f-chart method result in a rms error of 1.5%. The method provides an upper bound for the performance of the systems studied and the original anti $\theta$,f-chart method developed by Braun provides a lower bound. The actual performance of the system could be determined from the ASHRAE-95 standard test results.

36683 **(IEA-SHAC-TVI—2) Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors.** Chandrashekar, M.; Vanoll, K.H. (Waterloo Univ., Ontario (Canada); IST Energietechnik G.m.b.H. (Germany, F.R.)). Jun 1986. 53p. NTIS (US Sales Only), PC A04. File Number DE87900818.

This report details the data collection and performance reporting specifications for solar energy projects that were developed by the International Energy Agency Task on the Performance of Solar Heating, Cooling and Hot Water Systems Using Evacuated Collectors. It was developed so that the Task Participants could exchange and present information about individual installations, their operating characteristics and performance results in an accurate and consistent manner. One of the main objectives of the effort was to ensure accurate collection and reporting of data, facilitating analysis and exchange of information among the participants. This document is based on the 1980 International Energy Agency document on reporting format which has been considerably revised. Specific requirements concerning the preparation of diagrams, figures, plots and textural material have evolved permitting more detailed comparisons and exchanges of information among installations. Format requirements include both simulated and measured data.

36684 **(LA-UR—87-1531) Evaluation of materials by the energy yield of an active system.** Neeper, D.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8705122—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010105.

From International Energy Agency solar heating and cooling task X expert's meeting; Tokyo, Japan (11 May 1987).

This paper reviews the energy impact of materials on active systems for hot water and spece heating of buildings. The energy impacts of absorbers, heat transfer fluids, and thermal storage materials on active systems are well understood, and are described only briefly. The study of energy impacts of glazings has just begun, and initial results are presented.

36685 **(NMRDI—2-74-4625) Development of an innovative, low-cost solar collector: Final technical report.** Squires, M.P. (Squires Labs., Las Cruces, NM (USA). American Solar Products Div.). Jun 1987. 75p. NTIS, PC A04/MF A01 - NMRDI, 1220 South St. Francis Dr., Santa Fe, NM 87501. File Number DE87900811.

The goal of this contract was to develop and produce a "Low Cost Domestic Water Heating System," one that could be sold at a retail price of $500. This goal has been achieved. The primary effort was to reduce solar collector costs and, more specifically, the collector absorber plate costs. Plastic adhesive research, under this contract, resulted in the extensive use of silicone adhesives in a high performance solar collector which was also durable, reliable and easy to manufacture at a low cost. High thermal performance resulted from development of a silicone based conductive bond. The new collector has full pressure capability (150 psi Test, 100 psi Working), and can be manufactured in quantity at a materials cost of $55 and a labor cost of #3.35. The report includes detailed design descriptions, drawings, and photographs, of four different low cost solar collectros that were designed and built under this contract. Also, material listings and a step-by-step procedure for manufacturing the selected collector are included. NMSEI Performance Data for this new collector are compared to the certification data of the model SL-100 collector previously manufactured by American Solar Products.

36686 **(NP—7770124) High-temperature solar kilns for brickmaking - a contribution towards thermodynamic design of a system for the utilization of solar process heat.** Huettenhoelscher, N. (Dortmund Univ. (Germany, F.R.). Abt. Maschinenbau). 28 Jun 1985. 145p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770124.

The study covered a system for transforming radiated solar heat into process heat. The main system components are a concentration system and a combustion chamber with an integrated receiver. The immediate purpose planned is the firing of ceramic building materials in developing countries with plenty of sun (temperatures of up to 1270 K). A simulation model for the ceramic dimensioning of solar kilns was set up. This process made it possible to give an adequately accurate description of the performance of a solar kiln both experimentally and numerically. The study concentrated on working out an energy and thermal account, with the aid of which the thermodynamic performance of a solar kiln can be determined, taking into consideration specific parameters as a function of time and radiated solar energy. The overall system is described, as is the study of the optical concentration system, the concept of the combustion chamber, the efficiency level, the thermal account studies, the temperature distribution inside the combustion chamber, the development of the simulation model and the prototype solar kiln. (HWJ).

36687 **(SAND—85-2317-Rev.) The BDM Corporation modular industrial solar retrofit qualification test results.** Cameron, C.P.; Dudley, V.E. (Sandia National Labs., Albuquerque, NM (USA); EG and G/Washington Analytical Services Center, Inc., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010522.

Under the Department of Energy's Modular Industrial Solar retrofit project, industrial process steam systems incorporating line-focus solar thermal collectors were designed and hardware was installed and tested. This report describes the test results for the system designed by the BDM Corporation. The test series included function and safety tests to determine that the system operated as specified, an unattended operations test to demonstrate automatic operation, performance tests to provide a database for predicting system performance, and life cycle tests to evaluate component and maintenance requirements. Component-level modifications to improve system performance and reliability were also evaluated.

36688 **A design method for thermosyphon solar domestic hot water systems.** Malkin, M.P.; Klein, S.A.; Duffie, J.A.; Copsey, A.B. (Solar Energy Lab., Univ. of Wisconsin-Madison, Madison, WI 53706). *Journal of Solar Energy Engineering;* **109**: No. 2, 150-155(May 1987).

A modification to the f-Chart method has been developed to predict monthly and annual performance of thermosyphon solar domestic hot water systems. Stratification in the storage tank is accounted for through use of a modified collector loss coefficient. The varying flow rate throughout the day and year in a thermosyphon system is accounted for through use of a fixed monthly "equivalent average" flow rate. The "equivalent average" flow rate is that which balances the thermosyphon buoyancy driving force with the frictional losses in the flow circuit on a monthly average basis. Comparison between the annual solar fraction predicted by the modified design method and TRNSYS simulations for a wide range of thermosyphon systems shows an RMS error of 2.6 percent.

36689 **Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank.** Farrington, R.B. (Solar Energy Research Institute, Golden, CO). pp 1-5 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper describes the performance of a "loadside" heat exchanger immersed in a stratified tank designed for use in a solar energy space heating and hot water system. A load-side heat exchanger is one that removes energy from the storage tank by passing cool water through the heat exchanger. The measured heat transfer rate versus time is presented as is the calculated effectiveness as a function of the difference in temperature between the storage tank and the heat exchanger inlet. The effect of changing storage tank temperature definition on the calculated effectiveness is discussed and a method of using time constants to predict the heat transfer rate of immersed heat exchangers in a stratified tank is presented.

36690 **Determination of R-values from in-situ dynamic thermal test data in light weight roof systems.** Reddy, C.S. (State Univ. of NY, Utica, NY). pp 541-549 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The determination of thermal resistance (R-value) of building envelopes from in-situ measurements poses difficulties because field conditions are seldom in steady state. An averaging technique has been in common use for some time to obtain R-values from transient heat transfer measurements. In this paper, some deficiencies in the technique are investigated. It fails to provide meaningful values in situations such as moderate climates, and requires long testing periods in other cases. These conclusions are validated by the dynamic thermal experiments conducted in different seasons on two different roof specimens at the Roof Test Facility of the Oak Ridge National Laboratory.

36691 **Flow coefficients for interzonal natural convection for various apertures.** Mahajan, B.M.; Hill, D.D. (NBS, Gaithersburg, MD). pp 300-306 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Experiments to determine the flow coefficients for interzonal natural convection were carried out at the National Bureau of Standards' Passive Solar Test Facility. Interzonal natural convection was studied for ten different apertures under four different test conditions. One of the two zones was heated with baseboard electric heaters. The flow coefficients used in simple one-dimensional model for interzonal airflow vary with the aperture configuration, ratio of aperture area to wall area, and the level of heat input to the warmer zone. Variations in the flow coefficients are apparently due to the different flow fields and temperature distributions for each aperture configuration.

36692 **Effects of exposure testing on pipe insulation.** Bingham, C.E. (Solar Energy Research Institute, Golden, CO). pp 431-436 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper describes the physical and thermal effects of outdoor exposure (moisture, heat, and ultraviolet radiation) on the pipe insulation used in active-solar heating systems. Researchers performed American Society for Testing and Materials (ASTM) C335 tests for thermal properties of insulation on five types of pipe insulation commonly used in active-solar energy systems: elastomeric rubber, polyethylene, polyurethane, polyisocyanurate, and rigid fiberglass. Also tested were two types of coatings for elastomeric rubber.

36693 **Comparison of analytical and experimental immersed, collector-side heat exchanger results.** Farrington, R.B.; Bingham, C.E. (Solar Energy Research Institute, Golden, CO). pp 437-444 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper compares the results from testing four immersed heat exchangers to previous experimental data and from two of the heat exchangers tested to analytical and numerical models. These types of heat exchangers are typically used in indirect solar hot water systems between the collector subsystem and the storage subsystem. The experimental results show that the effectiveness decreases significantly at lower temperature differences between the heat exchanger inlet and a well-mixed storage tank. This not only leads to higher control system turn-off differentials but may be a

major reason that measured field performance of indirect systems is sometimes less than predicted.

36694 **Night ventilation strategies in dry climates.** Bleem, J.; Burns, P.; Winn, C.B. (Colorado State Univ., Fort Collins, CO). pp 959-966 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Night Ventilation, the use of outside air to cool the mass of a building at night, has been shown to reduce both auxiliary cooling energy usage and maximum cooling loads for buildings with significant "available mass." "Available mass" is defined as building mass which can be cooled at night, primarily by the effects of night ventilation, and which then absorbs heat from the conditioned space during the day. Energy and demand savings are realized due to the cooling storage effects of the mass. The present work involves determination of cost savings based on results from an analytical modelling process. A model is developed by solving air node energy balances throughout the day, which include the heat transfer into and out of the building mass. Available building mass is assumed to exist in the form of homogeneous, one-dimensional walls. Differential equations which describe the temperature distributions in the mass are developed, and these are coupled to the air node energy balance equations due to the convection boundary condition.

36695 **Interzonal mixed convection heat transfer in a passive solar building.** Kirkpatrick, A.T.; Hill, D.D.; Burns, P.J. (Colorado State Univ., Fort Collins, CO). pp 947-954 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Convective heat transfer through apertures such as doorways can be an important process by which thermal energy is transferred from one zone to another zone of a building. In this paper interzonal natural and forced convection in a two zone and a three zone full scale building are examined. Aperture velocity and temperature distributions are measured and the experimental interzonal mass flow rate and heat transfer are determined. A model based on zone temperature distributions is derived to predict the interzonal mass flow rate and heat transfer. The measured and predicted interzonal flow rate and heat transfer are compared and found to be in good agreement.

36696 **Flow measurement techniques in the evaluation of heat pump and fan performance.** Hewitt, H.C. Jr.; Ozdemir, B. (Tennessee Technological Univ., Cookeville, TN). pp 902-907 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A method of measuring the mass flow rate in an air-conditioning duct is most difficult to achieve without changing the flow conditions in the duct. This paper presents experimental evidence that the use of a rectangular orifice meter can accomplish this measurement with an accuracy of approximately +-2% that of an ASME long-radius nozzle even when a laminar boundary layer is not fully developed at the orifice. At this point the experimental data are limited to low subsonic flows in one specific rectangular duct. For the one condition tested here, it was possible to predict the mass flow rate that a rectangular duct would have if there were no orifices in the duct. This technique will be extremely valuable if it is verified in actual field tests because it will allow the evaluation of the heat pump in its true operational mode.

36697 **Performance of a solar desiccant cooling system.** Lof, G.O.G.; Cler, G.; Brisbane, T. (Colorado State Univ., Fort Collins, CO). pp 828-834 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A solar desiccant cooling system was operated at the Solar Energy Applications Laboratory, Colorado State University, throughout the 1986 summer. The system comprises an American Solar King fresh air heating/desiccant evaporative cooling unit, a Sunmaster evacuated tube solar collector, hot water solar storage tank, auxiliary electric boiler, controls and accessories. The cooling unit is operated in the ventilation mode, fresh air being dried in a rotating desiccant matrix, and cooled by heat exchange and evaporative cooling. Return air is used as a cooling medium in a rotating heat exchange matrix, heated by solar energy in a heat exchange coil, and discharged through the rotating desiccant bed. The solar-driven system provided over 90 percent of the seasonal cooling requirements in an experimental, residence type building at average COP levels of 1.0 and solar collection efficiencies of 50 percent when supplied with solar heated water at temperatures of 50 to 65C.

36698 **Overview: U.S. Department of Energy solar buildings technology program.** Neville, J.; Evans, D. (DOE, Oakland, CA). pp 774-778 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper provides a general, but by no means exhaustive, overview of the near-term goals and objectives of DOE's Solar Buildings Technology Program (Dr. David Pellish, Director - DOE, Washington, D.C.). It begins with some background information on progress to date and then reviews the general directions the Program is pursuing to improve solar energy's contribution to heating, cooling and lighting the Nation's buildings.

36699 **Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator.** Nelson, D.J.; Wood, B.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA). pp 933-940 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

In the present work, a numerical method has been applied to model the performance of a glazed collector/regenerator component of an open-cycle absorption refrigeration system. This two-dimensional model calculates local heat and mass transfer coefficients as part of the solution. The air flow in the glazed channel is driven by the combined buoyancy of both heat and mass transfer (water evaporation). Since the heat and mass transfer coefficients each depend on both of the driving potentials determined by local conditions in the falling film, a solution of the conjugate problem is required. The resulting nonuniform air-film interface conditions cause the local heat and mass transfer to differ significantly from the uniform boundary condition case.

36700 **Dynamic performance of absorption systems for control simulation.** Anand, D.K.; Fischi, R.; Helferty, J.; Herczfeld, P.; Brisbane, T. (Univ. of Maryland, College Park, MD). pp 926-932 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This study is concerned with the modeling, simulation and validation of the dynamic performance of a solar powered LiBr/H/sub 2/O absorption chiller. The specific form of the model is one that is amenable to control studies for which it is assumed that the operating range be limited to the region where no crystallization occurs. The model has been validated using experimental data from Colorado State University Test Facility (CSU). An analysis of the deviations between steady state computations and predictions show agreement to within <1%. The transient performance is dependent upon time constants whose evaluation is sensitive to settling time

and rise time of the perturbation itself. The time constants show scatter although the temperatures settle to the steady state value within two time constants.

## 1410 Solar Collectors And Concentrators

*REFER ALSO TO CITATION(S) 36644, 36699, 37369*

**36701 (CONF-870711—5) Microconvection effects at gradient zone boundaries.** Hull, J.R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011391.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

Microconvection in solar pond gradient zones is predicted to occur near the zone boundaries due to effects of boundary undulation and temperature modulation caused by impinging thermals in adjacent convecting zones. The equations that govern convective motion in a double-diffusive horizontal slab are solved for boundary conditions that incorporate these conditions. Solution of these equations predicts a weakened salinity gradient near the gradient zone boundary between the rising thermals. When the salinity gradient is too weak, instability occurs, taking the form of descending plumes seen in experiments.

**36702 (DTH-LV-R—86-12) Development of an efficient and inexpensive concentrating solar collector.** Kofod, P.; Hvid, J. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Dec 1986. 48p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752363.

At the Thermal Insulation Laboratory a new type of solar collector has been designed particularly for high temperature purposes. This solar collector has been tested and demonstrated on a 25 m/sup 2/ solar plant. The collector is a stationary compoud parabolic concentrator (CPC) with an evacuated tabular collector. It has proved a very promising performance, particularly at high temperatures (100-200 deg C). Thus, by an insolation of 800 W/m/sup 2/ and an absorber temperature of 180 deg C the collector efficiency was found to be 41%. At similar conditions the efficiency of normal evacuated tubular solar collectors is between 0-20%, and the efficiency of high temperature flat plate collectors is less than 5%. The design of this concentrating solar collector has been adapted to modern production methods, and according to Danish manufactures the production price will be less than 225 US per m/sup 2/. The collector is appropriate for a series of high temperature purposes, such as air conditions, cooling, water pumping, power generation, heat pumps amd process heat in general. A medicine cooler/ice pack freezer will be developed on the basis of a commercial absorption cooling unit to be powered by the developed CPC-collector. This system will be tested in India.

**36703 (IEA-SHAC-TVI—3) Characterization of evacuated collectors, arrays, and collection subsystems: A report of Task 6: The performance of solar heating, cooling, and hot water systems using evacuated collectors.** Guisan, O.; Mermoud, A.; Lachai, B.; Rudaz, O. (Geneva Univ. (Switzerland)). Jun 1986. 59p. NTIS (US Sales Only), PC A04. File Number DE87900827.

To characterize evacuated solar collectors, arrays and collection subsystems, this report brings together many analytical and empirical models and large quantities of technical information developed during many years of experimental investigations. These investigations have been conducted over the last ten years at twelve installations of the International Energy Agency Task on Evacuated Collector Systems. This material can be of enormous value to solar energy researchers and engineers in the design and analysis of solar energy systems and in formulating solar energy system models and design tools. Various definitions are given and their relation components and subsystems discussed. Capacitance, an important factor in being able to compare different systems, is treated. An analysis of simple to progressively more complex evacuated collector thermal performance models is given and it is shown that traditional approaches are not adequate. Stagnation temperature studies and models are discussed and related to estimating collector parameters. Incidence angle modifiers are particularly important aspects of the performance of many types of evacuated collectors. Modifiers are developed and it is shown how absorber tilt relative to the collector plane can be factored into the modifiers. Shading and other array effects are discussed. Values of a large number of collector, array and collection subsystem parameters are provided for each of the installations.

**36704 (N—87-20814) Solar power absorption in a glass tube.** Williams, M.D. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Apr 1987. 16p. (NASA-TM—89063; L—16055; NAS—1.15:89063). NTIS, PC A02/MF A01.

The optics of a glass tube to be used in near-Earth space at the focus of a solar concentrator has been examined, and an equation for the power absorbed from multiple-reflected light beams in the tube wall has been developed. The equation has been used to calculate the power absorbed by a highly transmissive form of fused silica. The equilibrium temperature reached by the tube with only radiative cooling has also been examined, and it shows a significant rise with large solar concentrations. The results apply specifically to cylindrical containment vessels for space-based solar-pumped lasers and generally to any similarly irradiated tubes.

**36705 (SERI/STR—211-3149) Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984.** Friedman, P.S.; Parent, C.R. (Owens-Illinois, Inc., Toledo, OH (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 204p. NTIS, PC A10. File Number DE87001172.

An investigation of luminescent solar concentrators (LSCs) was begun by the US Department of Energy (DOE) at Owens-Illinois, Inc., in 1978. Experimental and theoretical results of that investigation are summarized in this report. An assessment of the LSC technology was compiled to provide a concise description to guide future research in this field. Since 1978, tremendous progress was made in the development of this device as a practical nonimaging concentrator for achieving solar concentration ratios on the order of 10X. The two most important technical achievements appear to be first, the understanding that dye self-absorption of radiated energy is not as serious a problem as originally thought; and second, the demonstration that organic dyes in polymeric hosts are capable of surviving outdoors in bright sunlight for years without serious degradation. System efficiencies approaching 4% have been achieved for photovoltaic conversion and theoretical efficiencies on the order of 9% appear feasible for large-area devices.

**36706 (SERI/STR—255-3040) Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report.** Thornton, J.A.; Lamb, J.A. (Telic Co., Santa Monica, CA (USA)). Mar 1987. Contract AC02-83CH10093. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001167.

This report describes a project undertaken to investigate the use of sputtering. The study describes experiments in which 24-inch long receiver tubes were coated with Pt/$Al_2O_3$ graded cermet coatings by sputtering. Three coatings were examined: (1) cermets with graded Pt composition and $Al_2O_3$ antireflection layers; and (3) $Al_2O_3$-M-$Al_2O_3$ type coatings with Pt/$Al_2O_3$ M-layers. Sputter codeposition was used to form the cermet layers. Direct rf-sputtering of alumina and dc-reactive sputtering of aluminum were investigated as methods for depositing the $Al_2O_3$. The rf-sputtered $Al_2O_3$ was found to yield coatings with superior thermal stability. Thus, all three coating configurations were stable in air at 600°C. Absorptances were in the range from 0.90 to 0.95. The study concluded that graded cermet coatings were the most useful of the three types examined; optimized coatings on Pt-coated glass substrates yield absorptances of 0.97 and room-temperature emittances of about 0.08; alternative ir reflector layer materials were limited to low-temperature applications; substrate surface polishing is important in affecting the optical properties and thermal stability of coatings deposited onto engineering substrates; and an $Al_2O_3$ diffusion barrier was required to achieve maximum thermal stability for coatings deposited onto the engineering substrates.

**36707 Moderate axisymmetric deformations of optical membrane surfaces.** Murphy, L.M. (Solar Energy Research Institute, Golden, CO 80401). *Journal of Solar Energy Engineering:* **109**: No. 2, 111-120(May 1987).

Large deformable membranes are currently used as optical reflector surfaces for solar concentrators. In this paper, the authors study moderate axisymmetric deformations of optical membrane surfaces and their impact on the macroscopic optical quality of the deformed surface. A uniform pressure loading applied to an initially flat membrane surface is assumed in attaining the final concentrator surface shape. The problem is important in the design of focusing stretched-membrane heliostat modules. Insights into the design of stretched-membrane parabolic dish reflectors also result from this work. This paper presents several simple design and sizing relationships, based on a nonlinear variational principle, in terms of common engineering parameters. Good approximate predictions of the nonlinear load-deformation response and the stress state in the membrane are derived; simple but accurate predictions for membrane surface slope and nominal focal length also result.

**36708 Gas-particle flow within a high temperature solar cavity receiver including radiation heat transfer.** Evans, G.; Houf, W.; Greif, R.; Crowe, C. (Sandia National Labs., Livermore, CA 94550). *Journal of Solar Energy Engineering;* **109**: No. 2, 134-142(May 1987).

A study has been made of the flow of air and particles and the heat transfer inside a solar heated, open cavity containing a falling cloud of 100-1000 micron solid particles. Two-way momentum and thermal coupling between the particles and the air are included in the analysis along with the effects of radiative transport within the particle cloud, among the cavity surfaces, and between the cloud and the surfaces. The flow field is assumed to be two-dimensional with steady mean quantities. The PSI-Cell (particle source in cell) computer code is used to describe the gas-particle interaction. The method of discrete ordinates is used to obtain the radiative transfer within the cloud. The results include the velocity and temperature profiles of the particles and the air.

**36709 Consideration of the heat-removal factor for liquid-cooled flat-plate solar collectors.** Jones, G.F. (Los Alamos National Lab., NM). *Solar Energy;* **38**: No. 6, 455-458(1987).

This note concerns the investigation of the collector heat-removal factor as it applies to liquid-cooled flat-plate solar collectors. The heat-removal factor (F/sub R/) and companion factor F′ are positive dimensionless variables having values of 1 or less which were first introduced to facilitate the quick estimation of flat-plate collector performance. F′ is the ratio of the actual rate of heat collection from the collector to the rate of heat collection should the absorber surface and coolant temperatures be the same at each location along the coolant flow path. Alternately, F′ may be thought of as the ratio of thermal resistance between the fin and tube absorber surface and the outside to the thermal resistance between the coolant and the outside. Data and calculations for a broad range of liquid-cooled flat-plate collector geometries, materials of construction, and operating conditions.

**36710 Thermal design of new 'trumpet' secondary concentrators using computer modelling.** Suresh, D.; O'Gallagher, J.; Winston, R. (Univ. of Chicago, Chicago, IL). pp 155-160 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A nonimaging secondary concentrator deployed at the focal zone of a point focussing dish can increase its concentration ratio, or help relax the primary optical tolerance requirements. Enhancing the concentration by improving the optical performance of a large primary area is cost-prohibitive. Also, there are several high temperature studies that require a high thermal flux uniformly distributed over a considerably larger area than a mere spot. One of several geometries that can be used as a secondary in conjunction with a point focussing primary concentrator is a specifically designed hyperboloid of revolution, referred to as a 'trumpet.' Ray-trace analysis has shown that the flux distribution is strongly peaked (and hence a substantial thermal load) over a small neck area at the exit of the trumpet. In the present study, a quasi-transient heat transfer model has been developed to analyse the thermal behavior of passively cooled trumpets.

**36711 An assessment of the potential benefits of secondaries in point-focus concentrators.** Lewandowski, A. (Solar Energy Research Institute, Golden, CO). pp 150-154 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC02-83CH10093.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The Solar Energy Research Institute (SERI) has undertaken a program to assess the potential benefits of secondary concentrators in point-focus applications. A secondary concentrator can be used in two ways: (1) A secondary can be used to improve the overall concentration of a dish. (2) It can be used to relax the optical tolerances of the primary at constant concentration. A simple, analytical model was used to generate performance estimates for point-focus concentrators with secondaries. The analytical model was used to show the effects of three major variables: surface slope error, focal length-to-diameter ratio (f/D), and operating temperature.

**36712 CIRCE: Computer code for the analysis of point-focus solar concentrators.** Ratzel, A.C.; Boughton, B.D.; Mancini, T.R.; Diver, R.B. (Sandia National Labs., Albuquerque, NM). pp 136-144 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

In this paper a computer simulation code called CIRCE is discussed and examples of its application to several point-focus concentrating collector geometries are presented. CIRCE, an acronym for Convolution of Incident Radiation with Concentrator Errors, was developed from HELIOS, a large multipurpose cone optics computer code for the analysis of central solar receiver systems. CIRCE was developed with the objective of providing knowledgeable users with an easily used design tool which does not require a large investment of time to obtain results. In CIRCE, the concentrator errors are convolved with the solar intensity profile (sunshape) to produce the flux-density distribution on a specified target plane.

**36713 Moderate to large axisymmetric deformations of optical membrane surfaces.** Murphy, L.M. (Solar Energy Research Institute, Golden, CO). pp 366-374 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Large deformable membrane surfaces are currently used for solar concentrators. In this paper, the authors study moderate to large axisymmetric deformations of optical membrane surfaces and their impact on the macroscopic optical quality of the deformed surface. A uniform pressure loading applied to an initially flat surface is assumed in attaining the final concentrator surface shape. The problem is important in the design of focusing stretched-membrane heliostat modules. This paper presents several simple design and sizing relationships, based on a nonlinear variational principle, in terms of common engineering parameters.

**36714 Laboratory tests of cleaning techniques for immiscible solar ponds.** Bathen, K.H. (Univ. of Hawaii, Honolulu, HI). pp 183-188 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

A series of four solar pond tests, conducted from September 1982 to August 1983, were completed during a previous project to

observe the ability of several immiscible fluids to absorb and store solar energy. The change in heat storage performance and fluid characteristics, i.e. spectral transmittance, vertical stability, biocide impact and clarity, were examined following prolonged exposure to sunlight, wind and the addition of ambient dust and debris. These tests were continued from September 1983 and May 1984 examining techniques of cleaning and maintaining pond clarity without disturbing pond stratification or causing a significant loss of heat.

36715 **Preliminary investigation of a lightweight inflated conical concentrator for space applications.** Wood, R.L.; Wollam, E.J. (Solar Energy Research Institute, Golden, CO). pp 161-165 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The line-focussing conical concentrator is an often overlooked concentrator geometry that achieves the theoretical maximum geometric concentration for ideal "2-D" concentration (equal to the linear compound parabolic concentrator [CPC], $\pi$ times higher than the best parabolic trough) and can be easily and accurately produced from a simple flat sheet by inflating a closed, conical "bag." This paper presents possibly significant advantages that the inflated structure seems to have over the deployable dish structures now being planned by the National Aeronautics and Space Administration (NASA), primarily in stowed volume, mass, modularity, serviceability, susceptibility to damage, and moment of inertia. Probable advantages of the conical structure over proposed inflated paraboloid structures are also discussed.

36716 **Trickle-flow solar collector; far higher efficiencies during cold weather.** Thomason, H.E.; Thomason, H.J.L. Jr. (Thomason Solar Homes, Inc.). pp 991-999 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The water trickle-flow solar heat collector has unusual performance characteristics. As the ambient air-temperature goes LOWER, the efficiency of solar heat-collection goes MUCH HIGHER. Efficiencies ran more than 8 times as high during bitter cold January than during warm July, in Massachusetts. There was no overheating, no boiling hot water, no steam, and no pressure buildup to damage the collectors or the system. ASHRAE 93-77 solar heat-collector test procedures cannot be used to predict efficiencies of water trickle-flow collectors.

36717 **On the selection of distributed parameter models for control studies of solar energy systems.** Helferty, J.J.; Fischi, R.; Herczfeld, P.R.; Anand, D.K.; Brisbane, T.E.; Sugisaka, M. (Drexel Univ., Philadelphia, PA). pp 976-984 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper is concerned with the model validation and the determination of the dynamic time constants of the components of a solar collector loop having fluid as the heat transport medium. The approach taken is to model the collection loop by a series of components (i.e. collectors and pipes) together with a component interface region which gives the temperature profile across the boundary between two series connected components. The dynamic behavior of each component is modeled by the One Temperature Plug Glow (OTPF) model model (i.e. a first order bilinear partial differential equation) which gives the temperature profile of the component fluid as a function of time and distance along the collector. The dynamic behavior of the interface region is modeled only under stagnant conditions, and the model is given by a third order polynomial. This paper gives the results of the model validation experiment performed on the solar system installed on Solar House III at Colorado State University.

36718 **Optimization of parabolic trough collector design for developing country applications using a closed-form expression for intercept factor.** Guven, H.M. (San Diego State Univ., San Diego, CA). pp 669-675 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

In this paper, a closed form expression for intercept factor is used to carry out the optimization of parabolic trough collector geometry (rim angle and concentration ratio). It is shown that a simple computer code on a microcomputer, based on the presented closed-form expression, eliminates the need for a detailed ray-trace computer code and facilitates optimization of the collector optical design parameters. The results of the study indicate that, for applications requiring an operating temperature between 200 and 250°C, selecting a moderate geometric concentration ratio (less than 20) and a larger rim angle (greater than 100°) will yield an "error-tolerant" design. An error-tolerant trough design tolerates higher levels of random and systematic errors during operation, and it may be preferable for certain applications in developing countries.

36719 **Stress analysis of spherically curved triangular solar panels.** Lim, K.; Vallabhan, C.V.G. (Texas Technical Univ., Lubbock, TX). pp 646-652 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

For the development of a geodesic spherical solar bowl, spherically curved triangular solar reflectors are necessary and convenient. These solar reflectors consist of a thin glass plate elastically bent to form a spherical surface, glued onto a honeycomb backing and covered with steel plates at the back. Nonlinear von Karman plate equations are used to analyze the induced stresses in the glass plate as its deflections become large. The bending and membrane stresses are combined algebraically., and the absolute maximum principal stresses are computed. Nondimensional maximum stresses are plotted against nondimensionalized radius of curvature and the base angle of the isoceles triangle. These curves can be used to design spherically curved triangular solar panels.

36720 **Nondimensional parametric stress analysis of spherically curved rectangular solar panels.** Vallabhan, C.V.G.; Lim, K. (Texas Tech Univ., Lubbock, TX). pp 623-627 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Spherically curved solar reflectors consist of a thin glass plate elastically bent to form a spherical surface, glued on to a honeycomb backing and covered with steel plates at the back and with plastic strips on the sides. Nonlinear von Karman plate equations are used to analyze the induced stresses in the glass plate as its deflections become large. The bending and membrane stresses are combined algebraically, and the absolute maximum principal stresses are computed. Nondimensional maximum stresses are plotted against nondimensionalized radius of curvature. These curves can be used to design rectangular and spherically curved solar panels.

### 1420 Heat Storage

*REFER ALSO TO CITATION(S) 36714*

## 15 GEOTHERMAL ENERGY

### 1501 Resource Status And Assessment

36721 **(DOE/ID/12524—T2) Alaska geothermal bibliography.** Liss, S.A.; Motyka, R.J.; Nye, C.J. (comps.). (Alaska Dept. of Natural Resources, Fairbanks (USA). Div. of Geological and Geophysical Surveys; Alaska Dept. of Natural Resources, Juneau (USA). Div. of Geological and Geophysical Surveys; Alaska Univ., Fairbanks (USA). Geophysical Inst.). May 1987. Contract FG07-84ID12524. 261p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87011630.

The Alaska geothermal bibliography lists all publications, through 1986, that discuss any facet of geothermal energy in Alaska. In addition, selected publications about geology, geophysics, hydrology, volcanology, etc., which discuss areas where geothermal resources are located are included, though the geothermal resource itself may not be mentioned. The bibliography contains 748 entries.

### 1503 Geothermal Exploration And Exploration Technology

36722 **(ETSU-G—129A) Cleethorpes geothermal exploration borehole. Drilling and testing programme. General report .** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Rock Mechanics Ltd., Falmouth (UK)). Feb 1985. 60p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

As part of the UK hot aquifer geothermal energy research programme, a 2100 m deep exploratory borehole was drilled and tested at a site in Cleethorpes, South Humberside during May and June 1984. The research programme is being administered by the United Kingdom Atomic Energy Authority (UKAEA), acting as Principal for the Secretary of State for Energy, through the Energy Technology Support Unit (ETSU). The site development, drilling, casing and field testing carried out in 1984 are summarised and the operations are recorded to provide a reference document for any similar activities in the future.

### 1505 Economic And Financial Aspects

*REFER ALSO TO CITATION(S) 36729, 36730*

36723 **(ETSU-G—124A) WELC (version 1): well cost estimating.** Mortimer, N.D. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). May 1983. 80p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Report No. 5.1.

The WELC programme, which is written in microsoft BASIC for a BBC microcomputer, is a pre-feasibility cost estimating procedure for U.K. low-enthalpy geothermal wells with depths between 1000 and 4000 metres. The programme provides estimates of total drilling time and total costs, each with a breakdown into contributing components. A substantial amount of default data are incorporated into a programme which enables the user to operate it with limited information, as appropriate to an early stage of assessment, or pre-feasibility study. The minimum information required consists of total vertical well depth, total vertical depth to the top of the aquifer, type of well, the method of completion, and rock hardness classification. When default data are chosen for the price of drilling supplies and services total well costs are calculated in Pound sterling at early 1983 levels.

36724 **(ETSU-G—124B) Application of the WELC well cost estimating procedure.** Mortimer, N.D. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). May 1983. 20p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Report No. 5.3.

Examples of the initial application and assessment of the WELC microcomputer programme for the pre-feasibility cost estimating of U.K. low-enthalpy geothermal wells are presented. Some of the major factors which influence results from this programme are investigated and other sensitivities are examined. Comparison of estimated results, derived with the programme, and actual costs for a recently completed U.K. geothermal well suggests that the WELC procedure provides a reasonably reliable guide to well cost.

### 1508 Geothermal Power Plants

36725 **(DOE/SF/11653—T12) Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report.** Gallagher, J.S.; Linsky, D.; Morrison, G.; Levelt Sengers, J.M.H. (National Bureau of Standards, Washington, DC (USA). Thermophysics Div.). Apr 1987. Contract AI03-82SF11653. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87009866.

We present tables of thermodynamic properties, and dew and bubble properties, of a mixture of 90 mol % isobutane and 10 mol % isopentane, a working fluid in a binary geothermal power cycle. The tables are generated by a formulation of the Helmholtz free energy, in which the mixture properties are mapped onto the known properties of pure isobutane by means of the principle of generalized corresponding states. The data base for the Helmholtz free energy formulation is new. We report data obtained in three different apparatus: critical-line and isopentane vapor pressure data obtained in a visual cell; vapor-liquid equilibria data obtained in a mercury-operated variable-volume cell; and pressure-volume-temperature data for the 90 mol %-10 mol % mixture obtained in a semi-automated Burnett-isochoric apparatus. The principles of the methods, and estimates of the reliability, are discussed and all experimental data are compared with the surface. The results are tables of specific volume, enthalpy, entropy, specific heat and density and temperature derivatives of the pressure at 10 K temperature increments from 240 to 600 K along isobars from 0.01 to 20 MPa. Separate tables are prepared from the dew and bubble properties of the 90-10 mixture. Estimates of the effects of isomeric impurity of isobutane are given in graphical form.

### 1509 Geothermal Engineering

*REFER ALSO TO CITATION(S) 36723, 36724*

36726 **(SAND—87-0922C) Research in lost circulation control for geothermal wells.** Ortega, A.; Loeppke, G.E.; Givler, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-8704110—10). NTIS, PC A02. File Number DE87011718.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

This paper reviews recent progress at Sandia National Laboratories in the area of lost circulation control for geothermal wells. The Lost Circulation Program has three major elements: (1) Detection and characterization of loss zones, (2) Development of new techniques and materials for control of loss zones, and (3) Integration of the first two items for wellsite application. Most of our work to date has been in the area of developing new techniques and materials. We report here on progress that has been made in the past two years in the development of new, pumpable cementitious muds, in situ mixing and placement of polyurethane foams, and fundamental analysis of and materials development for particulate lost circulation materials. Plans for work in the area of zone detection and characterization, including development of a transient, lost circulation hydraulics simulator and field zone characterization using an advanced wellbore televiewer, are discussed.

### 1510 Direct Energy Utilization

*REFER ALSO TO CITATION(S) 37144*

**36727 (ETSU-G—126A) Geothermal report. Low temperature radiator systems. Stage 1. Acquisition and collation of design data.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Hoare Lea and Partners, Bristol (UK)). Aug 1984. 102p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

An interim report is presented covering results of a study to enable a radiator/convector system to be designed to operate at flow and return temperatures which would be compatible with a geothermal heat source. The information and data obtained as a result of visits to various component manufacturers and research organisations, and comments as to the relevance of this information to subsequent systems design are discussed, and the importance of further design information and additional testing which may be carried out, possible system design solutions and associated controls are considered.

**36728 (ETSU-G—126B-Pt.1) Geothermal aquifer studies. Heat pump study - preliminary review. Summary and recommendations.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Hoare Lea and Partners, Bristol (UK)). Dec 1984. 13p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given of the methods which may be used for combining heat pumps with geothermal aquifers from shallow to intermediate depths. Various types of heat pump cycle are discussed and indicative costs are presented. Specific examples of possible end uses are given. Finally recommendations for further work are presented.

**36729 (ETSU-G—126C) Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Hoare Lea and Partners, Bristol (UK)). Jun 1984. 23p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The potential and cost effectiveness of utilising geothermal energy from a proposed well close to the Lindsey Comprehensive School is assessed and it is concluded that it only appears to be cost effective if a suitable aquifer is found in the Permian Strata, yielding water at approximately 60°C. The water from the aquifer should then be used directly from the secondary side of the well head heat exchanger in a bivalent mode of operation with the existing fossil fuel source. The degree of modification to the school heating systems will determine how effective the utilisation can be and further investigation is warranted to ascertain how this can be implemented.

**36730 (ETSU-G—126D) Heat loads in Great Grimsby. An analysis of the practicalities and economics of a hypothetical geothermal scheme.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Hoare Lea and Partners, Bristol (UK)). Mar 1985. 60p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Includes Addendum, February 1986.

An analysis of the practicalities and economics of a hypothetical geothermal scheme located in Great Grimsby, Humberside is presented. It is concluded that the scheme, which has been considered in broad conceptual terms, is relatively practical. The economic analysis for heat supply only indicated a simple payback period of about 6 years when the costs of the district heating network are not included.

### 1520 Geothermal Data And Theory

**36731 (DOE/SF/15799—T12) Geothermal research at the Puna Facility.** Chen, B. (Hawaii Univ., Hilo (USA)). Jun 1987. Contract FG03-85SF15799. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011682.

This report consists of two research papers: (1) Isotopic and Mineralogical Analyses of Samples from the HGP-A Well; (2) Report on Kapoho Geothermal Reservoir Study at the Puna Facility. These papers contain results of recent research and outline future activities.

## 16 TIDAL AND WAVE POWER

### 1604 Economics

**36732 (ETSU-STP—1539(1)) Preliminary survey of tidal energy of U.K. estuaries.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Binnie and Partners, London (UK)). May 1980. 42p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The studies being carried out at the present time of tidal power schemes in the Severn estuary have resulted in the development of quick, reasonably accurate methods of assessing their energy outputs, likely cost and hence economic performance in terms of the cost of the energy produced. These methods have been applied to the six other UK estuaries having a reasonable combination of area and tidal range. The results show that Morecambe Bay and Solway Firth are large energy resources which would produce their energy out of phase with an ebb generation scheme in the Severn. A scheme in Morecambe Bay could produce energy nearly as cheaply as the second stage of the Severn scheme.

### 1605 Environmental Aspects

**36733 (ETSU-STP—4042) Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK .** Kirby, R. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Nov 1986. 243p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A detailed discussion of the most comprehensive field investigation of the turbidity maximum of an estuary carried out anywhere in the world to date is presented. Continuous profiling electro-optical turbidity and densimeter systems were developed specifically for the study. The regional distribution of both mobile and stationary suspensions in the various planes and on the various timescales of interest is examined. Sub-division into hourly plan views, show the cyclical alternation of entrainment, advection and settling of suspended sediment over the semi-diurnal timescale on spring tides. Stacking average vertical profiles across Standard Lines in their correct geographical sequence has allowed the average three-dimensional structure of the turbidity maximum on spring and neap tides to be defined. The processes giving rise to the distributions are considered, and the first detailed description of the various timescales and processes of the vertical and lateral mixing of mobile suspensions is given.

### 1607 Tidal Power Plants

*REFER ALSO TO CITATION(S) 36732*

**36734 (NEI-DK—19) Proposal of a floating tide power plant in Vestmannasund.** (Birch og Krogboe Raadgivende Ingenioerkontor, Virum (Denmark)). Nov 1986. 17p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752364.

Proposal for and ideas of a floating tide power plant. Drawings and description of an overall solution comprising a battery formation of axial turbines with variable pitch propeller. Size of plant adapted to the Faroese grid. Estimated annual output in Vestman-

nasund: 33 mill. kWh at c/sub p/ = 0,44 for twelve turbine units. Esimated price of plant incl. connection to grid: 100 mill. D.kr., excl. expenses for development.

# 17 WIND ENERGY

## 1701 Availability (climatology)

36735 **(NZERDC-P—114) Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report.** Smyth, V. (Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering; New Zealand Energy Research and Development Committee, Auckland). Jan 1987. 152p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87900816.

The work described in this report forms part of the New Zealand Wind Energy Resource Survey. It provides an overview of wind energy in New Zealand in terms of supply and demand. Supply is related to the meteorology and geography of the country. The general problems of extrapolation and interpolation of wind data both in space and time are discussed and current knowledge on the subject is reviewed. The indications using available wind data are that there is an abundance of wind turbine sites with mean wind speeds high enough to drive conventional large-scale turbines economically. The limitation on wind power usage would be the ability of the electricity grid to accept the fluctuating supply rather than the magnitude of the supply. A complete assessment of the economics of wind power requires simulation of the grid operation. However there are several points favorable to wind power which are elucidated. New Zealand has a hydro-based electricity system and this is particularly suitable for the incorporation of wind power. The geographical extent of the country permits the output from wind power to be steadied considerably by dispersing the turbine network widely. The supply of wind at times of high demand and high hydro storage water value is generally average to high. However on an inter-annual scale, dry years may be accompanied by lighter winds.

36736 **Improving the performance of mass-consistent numerical models using optimization techniques.** Barnard, J.C.; Wegley, H.L.; Hiester, T.R. (Pacific Northwest Laboratory, Richland, WA 99352). *Journal of Applied Meteorology;* **26**: No. 6, 675-686(Jun 1987). Contract AC06-76RL01830.

This paper describes a technique of using a mass-consistent model to derive wind speeds over a microscale region (about 4 $km^2$) of complex terrain. A serious limitation of these numerical models is that the calculated wind field is highly sensitive to certain input parameters, such as that used to simulate the atmospheric stability. Because accurate values for these parameters are not usually known, confidence in the calculated wind is low.

## 1705 Environmental Aspects

36737 **(ETSU-WN—1057/1) First report on the visual impact of large wind turbines.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Atkins (W.S.) and Partners, Epsom (UK)). May 1983. 39p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The aspects of visual impact were identified which are likely to be important and to need early study. It was concluded that the impact is likely to be significant in many, if not most, landscape types. The motion of the blades will increase the impact compared to that of static structures. Non-residents (ramblers, interest groups, etc.) will need to be considered as well as residents. The possibilities for the mitigation of any significant adverse impact and the techniques appropriate to more detailed studies were reviewed.

36738 **(TWC-P—8218) Noise prediction programme for wind turbines.** Garrad, A.D. (ed.). (Taylor Woodrow Construction Ltd., Southall (UK); Southampton Univ. (UK). Inst. of Sound and Vibration Research; UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Dec 1984. 46p. (ETSU-WN—5031-1). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is given on the near and far field noise levels from a wind turbine. Measured data from a small prototype machine at Cambridge University and a 20 metre wind turbine at Burgar Hill, Orkney are presented and compared to a mathematical model. The original inclusion of just propeller and rotor noise sources failed to reproduce the measured results. However, when an additional source of noise was included, the agreement was good.

## 1706 Wind Energy Engineering

36739 **(ERA—85-0017) Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis.** Delnon, R.J.; Johnson, R. (ERA Technology Ltd., Leatherhead (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Feb 1986. 83p. (ETSU-WN—0561/3). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A computer program is described for the simulation of the response of a horizontal axis wind turbine generator to atmospheric turbulence. The program represents a frequency domain model and is entitled FREDOM. Some results are presented and discussed for the application of the program to the 60 metre, phase 2, Orkney HAWT designed by the WEG consortium. Variations in mean windspeed, turbulence standard deviation and turbulent length scale are examined. Further results are presented on diameter variations using scaled versions of the 60 metre machine. The program output comprises basically torque and blade flapping spectra.

36740 **(ETSU-WN—5055) Adaptive pitch control of a 25m wind turbine generator.** Bossanyi, E.A. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Dec 1986. 51p. (TWC—014V-86-3143). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The WEG 'MS2' 250 kW wind turbine uses full-span blade pitch control to regulate power output above rated wind speed. A digital controller, acting on a measurement of power output, controls the pitch angle. The computer simulation study described aims to improve the control algorithm in order to reduce power and shaft torque fluctuations without making excessive demands on the pitch change servo motor. Adaptive control algorithms, are investigated, and a different adaptive control algorithm, based on a state-space prediction model, is found to give good results without requiring any additional measurements. A programme of experimental testing of this algorithm is therefore recommended.

36741 **(NEI-DK—20) Construction and testing of a Darrieus wind turbine. Demonstration plant.** Jensen, M.T. (Skibsteknisk Laboratorium, Lyngby (Denmark)). Jul 1986. 58p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752365.

A Darrieus demonstration wind turbine has been constructed og tested during the period 1985-86. Dimensions, components, fabrication, and evaluation of commercial prospects are described. The mechanical effect varied from 0.20 to 6.90 KW, the power effect from 0.20 to 4.90 KW depending on wind velocity. (EG).

36742 **(SAND—87-0501) VAWT stochastic wind simulator.** Strickland, J.H. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87010532.

A stochastic wind simulation for VAWTs (VSTOC) has been developed which yields turbulent wind-velocity fluctuations for rotationally sampled points. This allows three-component wind-

velocity fluctuations to be simulated at specified nodal points on the wind-turbine rotor. A first-order convection scheme is used which accounts for the decrease in streamwise velocity as the flow passes through the wind-turbine rotor. The VSTOC simulation is independent of the particular analytical technique used to predict the aerodynamic and performance characteristics of the turbine. The VSTOC subroutine may be used simply as a subroutine in a particular VAWT prediction code or it may be used as a subroutine in an independent processor. The independent processor is used to interact with a version of the VAWT prediction code which is segmented into deterministic and stochastic modules. Using VSTOC in this fashion is very efficient with regard to decreasing computer time for the overall calculation process.

36743 **(SL—1270.84918) Measurements of power quality for a modern wind turbine.** Jensen, S.A.; Kristensen, J.W. (Skibsteknisk Laboratorium, Lyngby (Denmark)). Sep 1985. 85p. (In Danish). Danish Maritime Institute, Library, Hjortekaervej 99, DK-2800 Lyngby.

This report contains some results of measurements carried out on a 3-bladed 55 kW Horizontal-Axis-wind-turbine (HAWT). The wind turbine is connected to the public supply network and the purpose of the measurements was to investigate the disturbances in the supply system caused by the wind turbine. The investigations were carried out for different types of terrain in order to see if the turbulence of the wind had any influence on the disturbances in the supply system. The measurement programme included the following types of measurements: 1. Measurements of power, voltage, number of cut- ins of the generators, wind speed, and wind direction during a period of several days. Scan frequency 1 Hz, average period 1 min. 2. Measurement of power, voltage, current and wind speed during cutin of the generators to supply network. Maximum band width of the measurement equipment: 10 kHz. 3. Measurements of power, voltage, current and wind speed during a period of approximately two hours. Maximum band width of the measurement equipment: 10 kHz. The results in this report are primary represented as time history plots. The project was financed by the Technological Council of Denmark and the association of wind turbine manufacturers in Denmark.

36744 **(YR—2788-Vol.1) Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Dec 1982. 104p. (Y—2407; ETSU-WN—5018-1A). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The report presented is concerned with studies of three types of aerogenerator transmission systems namely, fixed pitch rotor hydraulic, variable pitch rotor mechanical, and fixed pitch rotor mechanical, each type being considered in three sizes. The study covers systems design, control, performance, reliability/availability, weight, wind speed effects from three sites, energy yields, and energy costs. The principal results and conclusions discussed include that for many applications, the principal advantages of the hydraulic system compared with the variable pitch mechanical system are unlikely to outweigh its principal disadvantages e.g. lower energy yield, higher energy costs, and development requirements, the fixed pitch rotor mechanical system is the least attractive of the three types of system, and for all the systems, high wind speed sites are preferred because they yield more energy at significantly lower unit energy costs.

36745 **(YR—2788-Vol.2) Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Dec 1982. 35p. (Y—2407; ETSU-WN—5018-1B). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The second of two volumes presented is concerned with studies of three types of aerogenerator transmission systems. Costs, computer program input, selected references and energy yields are discussed.

36746 **Structural design and fabrication of the Sandia 34-meter vertical axis wind turbine.** Ashwil, T.D. (Sandia National Labs., Albuquerque, NM). pp 194-200 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—).

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The Wind Energy Research Division of Sandia National Laboratories has been funded by the Wind/Ocean Technology Division of the Department of Energy (DOE) to design and build a 34-meter diameter Vertical Axis Wind Turbine (VAWT). The turbine design incorporates the results of recent VAWT research in aerodynamics and structural dynamics. Initial system concept studies identified several blade options that met the required power rating of 500 kW. The final blade and rotor configurations were chosen based on finite element calculations that determined the turbine modes of response, their frequency of vibration, and stress levels. For parked survival turbine components were designed to withstand the loading of a 150 mph (67.0 m/s) wind coupled with maximum cable tensions.

36747 **Sandia National Laboratories 34-meter diameter vertical axis wind turbine test bed.** Klimas, P.C. (Sandia National Labs., Albuquerque, NM). pp 189-193 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC04-76DP00789.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

Sandia National Laboratories has designed, procured, and is erecting a 34-meter diameter vertical axis wind turbine test bed. The turbine incorporates many innovative features to investigate possible reductions in the cost-of-energy produced by wind energy conversion systems. These features include: blade element airfoil sections designed specifically for wind turbines, variable chord-variable section modular blades, stress reducing discontinuous slope blades, and variable speed-constant frequency generation capabilities. The modular blades allow for relatively simple partial configurational changes. Based on Sandia's twelve years of wind turbine research and testing, the test bed is heavily instrumented.

36748 **Empirical model for near-to far-field wakes behind a smooth cylindrical pole tower.** Bentley, C.L. Jr. (Dept. of Physics, Prairie View A and M Univ., Prairie View, TX). pp 19-26 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The velocity profile in the near-field wake region downstream of a smooth circular cylinder was obtained from wind tunnel tests. An empirical model summarizing the new, as well as the previously surveyed, wake characteristics is presented. Even though the mathematical model was developed to describe near-field wakes, it converges to the well publicized Schlichting standard wake model in the far-field region. Local wake velocity-profile diagrams are also presented to compare the model results with wind tunnel test results.

36749 **Reliability aspects of wind/diesel hybrid generating systems.** Rumbaugh, J.H. (Office of Solar Electric Technologies, U.S. Dept. of Energy, Washington, DC). pp 11-14 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Wind/diesel hybrid systems are an attractive approach to supplying power at reduced cost, especially in remote locations. In addition to being more cost-effective, hybrid systems must also be reliable. In this regard, many possible configurations of wind turbines and diesels are possible, ranging from simple parallel systems to those with multiple diesels, some with direct shaft coupling and

storage. New system control and operating strategies are required for wind/diesel hybrids to achieve their full potential.

# 20 ELECTRIC POWER ENGINEERING

**36750 (ORNL—6380) Energy Division annual progress report for period ending September 30, 1986.** (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 277p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87011964.

This report describes work done by staff of the Energy Division of Oak Ridge National Laboratory during FY 1986. The work of the Division is quite diversified, but it can be divided into four research themes: (1) technology for improving the productivity of energy use; (2) technology for electric power systems; (3) analysis and assessment of energy and environmental issues, policies, and technologies; and (4) data systems research and development (R and D). The research is supported by the US Department of Energy (DOE), numerous other federal agencies, and some private organizations. 190 refs., 60 figs., 23 tabs.

## 2001 Power Plants And Power Generation

*REFER ALSO TO CITATION(S) 36257, 36365, 36429, 36580, 36770, 36771, 36946, 37276, 37367, 37368*

**36751 (EPRI-AP—5276) Availability analysis of an integrated gasification-combined cycle: Final report.** (Arinc Research Corp., Annapolis, MD (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 179p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920478.

The Electric Power Research Institute (EPRI) contracted with ARINC Research Corporation to perform availability assessments of an integrated coal gasification-combined-cycle (IGCC) design. The objective of the study was to quantify the availability impact associated with several design and operating options specified by EPRI. In addition, several scheduled maintenance options for the IGCC plant were evaluated. The IGCC plant addressed in this analysis employs many modular design features that give the plant high equivalent availability through redundancy. The study focused on evaluating and quantifying the expected changes in unit capability, equivalent availability, and heat rate associated with various design alternatives. The findings of the baseline case studies are as follows: (1) The Baseline IGCC design using four gasifiers with 11.2% spare gasification capacity and three combustion turbine/HRSGs sets will have an expected equivalent availability of 86.18% and an average heat rate of 9002 Btu/kWh. (2) The Baseline with Supplemental Firing design using four gasifiers with the 11.2% spare gasification capacity being used to produce supplemental steam and with three combustion turbine HRSG sets will have an expected equivalent availability of 85.64% and an average heat rate of 9147 Btu/kWh. (3) The Baseline with Natural Gas Backup design using four gasifiers and three combustion turbine/HRSG sets with supplemental natural gas backup will have an expected equivalent availability of 91.53% with an average heat rate of 8981 Btu/kWh and a coal-to-natural gas fuel mixture of 23:1. 49 figs., 66 tabs.

**36752 (EPRI-CS—5235) Recommended practices for operating and maintaining steam surface condensers: Final report.** Bell, R.J.; Conley, E.F. (Heat Exchanger Systems, Inc., Boston, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 241p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920500.

This document is a guideline for the operation and maintenance of steam surface condensers developed for the Electric Power Research Institute. It is intended to assist plant engineers, operators and maintenance personnel in improving the availability and performance of the steam surface condenser. The guideline includes a primer on the theory of operation of steam surface condensers. Also included is a brief description of typical condenser problems. These introductory sections lay the groundwork for assisting operators and engineers in trouble-shooting, to maximize condenser performance and availability. The remaining sections concentrate on specific topics, such as performance monitoring, layup, and corrective action. Corrosion monitoring, maintenance methods including cleaning, plugging, corrosion countermeasures, and other corrective actions are also addressed.

**36753 (EPRI-EL—3359-Vol.3) Improvement in accuracy of prediction of electrical machine constants and generator models for subsynchronous resonance conditions: Volume 3, Development and benefit assessment of finite-element-based saturation model: Final report.** Chari, M.V.K.; Minnich, S.H.; Schulz, R.P. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.; Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 169p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920436.

This report describes the construction of an algorithm for expressing the variation, with generator operating point of generator saturated reactances based upon nonlinear electromagnetic steady-state finite-element calculated values. The algorithm is suitable for insertion into a power systems stability code. Steady-state load angles and field currents calculated for two generators have been validated against test data obtained by the owners. Coding procedures for the insertion of the algorithm into a systems stability code and the results of an 1100 bus power transfer study are described. The results indicate that the finite-element based saturation algorithms confer an advantage in accuracy over conventional saturation functions and provide an estimate of the economic benefit of its use. 15 refs., 73 figs., 28 tabs.

**36754 (EPRI-EL—4286-Vol.5) Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report.** Anderson, J.M.; LaForte, J.T.; Lynn, A.L.; McCoy, R.M.; Owen, E.L.; Rhudy, R.G. (General Electric Co., Schenectady, NY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 260p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920466.

Volume 5 of EPRI project RP 1763-2, "Improved Motors for Utility Applications," documents work performed by the General Electric Company on Task 3.1, Motor Winding Impulse Capability. The objective of this work was to identify opportunities to improve winding performance and hence motor reliability. An analysis that calculates the distribution of impulse voltage among the coils and turns of an ac rotating machine stator winding was developed and presented. Basic tests were also taken on the impulse voltage capability of representative stator insulation systems. In Stage 1, tests were conducted on unaged specimens; in Stage 2, tests were conducted on specimens aged by voltage from conductor to ground; in Stage 3, tests were conducted on specimens aged by voltage from turn to turn; in Stage 4, tests representative of stages 1, 2 and 3 were selectively conducted on coils. Test results are presented. 19 refs., 32 figs., 29 tabs.

**36755 (ORNL/TM—10206/P1) Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys).** Swindeman, R.W.; Goodwin, G.M.; Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011959.

Tests were initiated to evaluate the potential of a group of developmental iron-nickel-chromium alloys for service at 700°C with a target design stress of 60 MPa. Tensile, creep, stress rupture, weldability, and microstructural stability tests were conducted on one group of alloys, which are essentially modifications of type 316 stainless steel. The data for the alloys were compared to data for type 316 stainless steel, alloy 800H, and 17-14CuMo stainless steel. Results of the short-time screening tests indicate that the developmental alloys are superior to the commercial alloys in regard to strength. Annealing at 1115°C produced a loss in strength, but it was found that the loss could be mitigated by the judicious selection of composition, annealing conditions, and cold work prior to aging. The alloys were found to be unsatisfactory in regard to autogenous weldability; they exhibited a tendency for hot cracking. However, the steels could be joined satisfactorily with Inconel 82

and 17-14CuMo stainless steel filler metals. Compositions were identified that will be produced as small heats of tubing for subsequent fabricability, corrosion, and mechanical testing. Preliminary data relating to the fabricability and short-time mechanical properties were obtained for a second group of alloys. There were modifications of alloy 800H and contained molybdenum, niobium, and boron additions. Results indicated that significant improvement in strength is possible in the alloys containing 20% chromium and 30% nickel. 10 refs., 35 figs., 9 tabs.

**36756 (PB—87-178299/XAB) Study of saline water use at the Harry Allen Generating Station. Final report.** Laughlin, J.K. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). 28 Nov 1986. 71p. NTIS, PC A04/MF A01.

The study evaluates the use of saline water from the Lower Virgin River as a water supply to the proposed Harry Allen Generating Station near Las Vegas, Nevada. The objectives of the study included the technical and economic evaluation of the in-plant cost differences for water supply using either the Lower Virgin River Unit water or Clark County secondary treated sewage effluent as the sources for the Harry Allen Generating Station.

**36757 (STEV-VIND—87-5) Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades.** Hylander, J. (Statens Energiverk, Stockholm (Sweden)). 1986. 126p. NTIS (US Sales Only), PC A07. File Number DE87752399.

In this thesis a mathematical model has been implemented on a computer and used to calculate the harmonic components of the currents and electrodynamic torque in an induction machine equipped with a convertor connected to the rotor winding. The harmonics in the rotor current, created by the convertor, will influence the stator current frequency spectrum and produce pulsating torques. These well-known drawbacks of induction machines with rotor cascades, which are investigated both with calculations and measurements, can be reduced or eliminated by several methods. Here two methods are presented: control of the dc link and a twelve-pulse rotor cascade. By measuring the electrodynamic torque and controlling the grid-connected inverter of the dc link, calculations have shown that it is possible to reduce the pulsating torques. The other presented method, a twelve-pulse rotor cascade, needs an extra six-pulse rectifier and a three-winding transformer (DELTA/IPSILON DELTA) or a modified rotor winding, compared with the common rotor cascade. Calculations have been performed on a model with a modified rotor circiut with the two three-phase windings displaced 30 electrical degrees, which is equivalent with a three-winding transformer connected DELTA/IPSILON DELTA. The calculations, as well as measurements on an induction machine connected to a twelve-pulse rotor cascade and three-winding transformer, show that the pulsating torque and frequency content of the stator current can be reduced.

**36758 (TKK-KO/ET—20) Some experimental results from a new type of evaporator for heat pumps.** Ghazanfari, A.-R.; Fagerholm, N.-E. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752378.

A new type of evaporator for heat pumps has been designed and tested. This evaporator can handle polluted and very low temperature heat sources. Overall heat transfer coefficient of this evaporator is higher than many others and it is easy and cheap to build.

**36759 Generating plant life upgrade strategy and results.** Rasmussen, J.E. (Generating Engineering and Construction, Potomac Electric Power Co., Washington, DC). pp 85-92 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

Extending the useful life of existing electric generating plants is an important part of the planning in the Potomac Electric Power Company and it is one of the most challenging and potentially rewarding being pursued today in the industry. There are many facets to this concept and there are numerous approaches being taken by different utilities. This report is an outline of the salient features of the PEPCO life extension program and the progress we have made to date on the Potomac River Plant including over two years of operation.

## 2002 Environmental Control Technology

*REFER ALSO TO CITATION(S) 36326, 36328, 36329, 36330, 36334, 36617, 36752, 37606, 37609, 37610, 37611, 37849, 37856*

**36760 (CONF-851123—12) Properties of CuO sorbents related to $SO_2$ reactivity.** Hedges, S.W.; Diffenbach, R.A.; Fauth, D.J. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011759.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

Copper oxide is a promising sorbent for combined flue-gas-cleaning processes because it is one of the most reactive metal oxides for the sorption of $SO_2$ from synthetic flue gas. In addition, $CuSO_4$ catalyzes the reduction of nitrogen oxides by ammonia. Preparation and regeneration schemes for unsupported CuO have been investigated to optimize the reactivity of the sorbent material. Sorbent effectiveness for flue gas desulfurization is discussed in relation to physical properties of the CuO powders.

**36761 (PB—87-175832/XAB) Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987.** Jones, J.W.; Emmel, T.E.; Laseke, B.A. (Radian Corp., Research Triangle Park, NC (USA)). Mar 1987. 20p. NTIS, PC A02/MF A01.

The paper gives results of estimating performance/costs of retrofitting pollution control technologies at 12 coal-fired power plants. In cooperation with the states of Ohio and Kentucky (in conjunction with EPA's state acid-rain program), efforts were undertaken to visit and conduct detailed evaluations of 12 coal-fired plants--5 in Ohio and 7 in Kentucky and the Tennessee Valley Authority system. A variety of commercial and advanced $SO_2$ and NOx control technologies--including precombustion, combustion (in-furnace), and post-combustion (flue-gas cleanup) technologies--were applied to each plant through conceptual designs. Retrofit factors (applied to the capital cost of a new pollution-control system), cost adders (e.g., movement of existing equipment), and costs were developed for applying the control technologies to the boilers of each plant. Results of these and subsequent efforts will be valuable in evaluations of acid-deposition control strategies by federal and state agencies and by electric utilities.

**36762 (PB—87-181921/XAB) Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report.** Kumar, S.; Timbre, K.; Pfeffer, N.; Kahler, M. (Martin Marietta Environmental Systems, Columbia, MD (USA)). Sep 1986. 37p. NTIS, PC A03/MF A01.

This report examines the air-quality impact of the proposed addition of two new diesel units to the two existing diesel units at Easton Utilities Commission Power Plant No. 2. The EPA-approved Industrial Source Complex (ISC) dispersion model was used to predict ground-level concentration impacts from Power Plant No. 2. Five years (1968-1972) of meteorological data characteristic of the site were used for the analysis. It was concluded that the projected emissions from the proposed addition would not cause or contribute to violations of the applicable air-quality standards.

**36763 (PB—87-182879/XAB) National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file.** Mobley, J.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1980. mag tap. (EPA—600/7-86/056B). NTIS CP T02.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording

mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—87-182887.

The focus of emission-inventory activities within the National Acid Precipitation Program (NAPAP) is to estimate emissions of pollutants of concern to the acid-deposition phenomenon. Electric utilities emit a large share of total acid-deposition precursor emissions. The purpose of the study was to produce a 1980 utility data base that met the needs of NAPAP task groups for utility data. Special emphasis was placed on meeting data needs of atmospheric modelers, emissions forecasters, and policy analysts. The product of the analysis, the NAPAP Utility Reference File, now serves as the source of emissions data for the 1980 NAPAP emission inventory. It also serves as the source of operating and economic data for utility simulation models. Because both fossil and non-fossil units are included, the total number of units is more than 11,000. Utility NOx and $SO_2$ emission estimates made using NAPAP Utility Reference file data for 1980. Six data files are included on the tape: four NAPAP update files and both the existing and announced Unit Inventory files. These are derivative files of the NAPAP Utility Reference Files (NURF). These files contain 1980-based electric utility related unit-level data. The NAPAP update files include corrected and added data on all electric utility generating units, fuel-specific emission data, stack-parameter data, and announced or coal-converting units. The existing Unit Inventory contains unit-specific data on larger generating units and aggregated information on smaller ones: the announced Unit Inventory contains data on those units coming on-line or planned for coal-conversion data after 1980.

36764 **(PB—87-182887/XAB) National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986.** Pechan, E.H.; Wilson, J.H.; Graves, K.K. (Pechan (E.H.) and Associates, Inc., Springfield, VA (USA)). Dec 1986. 157p. NTIS, PC A08/MF A01.

For system on magnetic tape, see PB—87-182879.

This report gives results of a study to produce a 1980 utility data base that meets the needs of National Acid Precipitation Assessment Program (NAPAP) task groups for utility data. (NOTE: The focus of emission-inventory activities within NAPAP is to estimate emissions of pollutants of concern to the acid-deposition phenomenon. Electric utilities emit a large share of total acid-deposition precursor emissions.) Special emphasis was placed on meeting data needs of atmospheric modelers, emission forecasters, and policy analysts. The product of the analysis, the NAPAP Utility Reference File (NURF), now serves as the source of emissions data for the 1980 NAPAP emission inventory. It also serves as the source of operating and economic data for utility simulation models. Because both fossil and non-fossil units are included, the total number of units is more than 11,000. Utility NOx and $SO_2$ emission estimates made using NURF data for 1980 are 6.5 million and 17.5 million tons, respectively.

36765 **(PB—87-188892/XAB) Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986.** Cetegen, B.M.; Johnson, T.R.; Payne, R.; Moyeda, D.K.; Sheldon, M.S. (Energy and Environmental Research Corp., Irvine, CA (USA)). May 1987. 416p. NTIS, PC A18/MF A01.

The report describes an evaluation of the mixing of jets of calcium-based sorbents injected into large wall-fired coal-burning utility-boiler furnaces for sulfur dioxide ($SO_2$) emission control. Pilot scale combustion experiments at 1.41- and 24-MW thermal input tested the dependence of overall sulfur removal efficiency on injection parameters and sorbent type. Several computational and empirical models of jet behavior were adapted for use in sorbent-injection system design. An effective injection-system design methodology is based on a hierarchy of design and interpretation procedures. The methodology includes: (1) use of simple empirical jet relationships to provide preliminary estimates for injection-system parameters (number, size, and velocity of jets); (2) isothermal physical flow modeling of the boiler to evaluate and optimize injection system mixing parameters; and (3) coupling of jet mixing results with experimental sorbent sulfation data, or sulfation calculations, to predict the impact of mixing on overall $SO_2$ capture.

36766 **(STEV-BMF—87-1) Thermal oxidation of waste from wet-dry flue gas desulfurization and reuse of the final product.** Nilsson, B. (Statens Energiverk, Stockholm (Sweden)). 18 Nov 1986. 123p. (In Swedish, English and German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752398.

A full scale demonstration plant for oxidation of spraydryer FGD waste product has been constructed and operated. The operating principle is oxidation of sulphite to sulphate in a fluidized bed reactor and simultaneous pelletization of the resulting product. The oxidation of the FGD waste product is almost complete in the whole operating range tested. The pelletization is high in the operating range that was found to be most convenient for commercial plants. To some extent a de-chlorination of the resulting product is possible simultaneously with the oxidation. The resulting product (technical anhydrite) has been shown to have a market as a binding time regulator in cement. It is expected also to fit as a construction material in underground coal-mines.

## 2003 Power Transmission And Distribution

*REFER ALSO TO CITATION(S) 37367*

36767 **(CONF-870757—1) Adaptive transmission relaying concepts for improved performance.** Rockefeller, G.D.; Wagner, C.L.; Linders, J.R.; Hicks, K.L.; Rizy, D.T. (Electric Research and Management, St. Rose, LA (USA); Electric Research and Management, Export, PA (USA); Stone and Webster Engineering Corp., Boston, MA (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010401.

From IEEE Power Engineering Society summer meeting; San Francisco, CA, USA (12 Jul 1987).

Concepts for adaptive protective relaying of transmission lines are presented. These include changes in on-line relay settings, relay characteristics or logic in response to power system or environmental changes, or as a result of operating experience. Such changes as line-out or generator-out contingencies, which affect fault current distributions and degrade the system's security level, initiate adaptive protection system (APS) responses. Adaptive relaying is shown to be capable of improving relaying reliability and power system security plus achieving better utilization of transmission facilities. Most of the concepts require a hierarchical computer system, involving front-line, parallel processors, a substation host and remote central processors, linked by channels that transmit data or relaying changes prior to or after a disturbance. Maximum value from adaptive relaying will result from integration with existing or planned substation control and data acquisition (SCADA) functions and interfacing with the central energy management system (EMS). Emphasis is placed on use of interim hardware approaches to allow evolutionary development, starting with just local signals and the first level of a hierarchy. 7 refs., 11 figs.

36768 **(CONF-870757—2) Adaptive transmission system relaying.** Horowitz, S.H.; Phadke, A.G.; Thorp, J.S. (AEP Service Corp., Columbus, OH (USA); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA); Cornell Univ., Ithaca, NY (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02. File Number DE87010394.

From IEEE Power Engineering Society summer meeting; San Francisco, CA, USA (12 Jul 1987).

The adaptive concept, as it is developed in this paper, is the concept that relays, or relay systems, can be responsive to temporary changes in system configuration or parameters. The implementation of this concept is based on the availability of a microprocessor-based system of protection. This paper covers adaptive possibilities of transmission system protection philosophy, transmission line protection, relay settings, transformer protection, and automatic reclosing. 11 refs., 4 figs. (DWL)

**36769 (CONF-870877—1) Impact of adaptive protection on power system control.** Phadke, A.G.; Thorp, J.S.; Horowitz, S.H. (Virginia Polytechnic Inst., Blacksburg (USA); Cornell Univ., Ithaca, NY (USA); AEP Service Corp., Columbus, OH (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009818.

From 9. power system computation conference; Lisbon, Portugal (30 Aug 1987).

Use of computer based protection seems to be well accepted by the Electric Utility Industry. The newer concept of an integrated computer system for protection, monitoring and control of substations is also gaining favor among power system engineers. Such a system permits many innovations in protection and control of power apparatus within the substation, as well as on a system-wide basis. One such new concept is that of Adaptive Protection. Through measurements obtained from computer based protection systems, many features of the protection and control system can adapt to changing state of a power system. In the present state of technology, these features (or settings) are based upon certain assumed system conditions and loading levels. As the actual system conditions change, these compromise settings are no longer optimum, and may in certain circumstances be wrong for the prevailing state of the system. The paper presents conceptual design of several adaptive protection and control functions. A more detailed account of four functions: adaptive detection and control of instability, load shedding and restoration, out-of-step relaying, and adaptive synchronization - check relaying is given. The role of high speed communication channels in providing the adaptive ability is also being explored. 9 refs., 4 figs.

**36770 (EPRI-EL—5179) Composite generation-transmission expansion planning: Final report.** Pereira, M.V.F.; Pinto, L.M.V.G.; Oliveira, G.C.; Cunha, S.H.F. (Electric Power Research Inst., Palo Alto, CA (USA); Centro de Pesquisas de Energia Eletrica, Rio de Janeiro (Brazil)). Jun 1987. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920474.

The objectives of this research are (1) to investigate compatible system performance indices for a generation/transmission system that can be "translated" in terms of load curtailment; (2) assess the applicability of sensitivity analysis of system performance as part of different system planning tools, ranging from interactive computer programs to "stand-alone" optimization codes. Case studies with the transmission system of Southern Brazil will be presented and discussed. 36 refs., 19 figs., 20 tabs.

**36771 Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review.** Burrage, L.M.; Hettwer, P.F.; McConnell, B.W. (Cooper Industries, McGraw-Edison Power Systems, Franksville, WI 53126). pp 159 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—).

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

An increasing concern has been exhibited by the Department of Energy (DOE), utility companies, and manufacturers of electrical power apparatus with respect to the dielectric integrity of todays power systems and power system components in the presence of Steep Front, Short Duration (SFSD) voltage impulses. Impulses of this type are characterized by their rise times of 10-250 nanoseconds and durations extending up to several microseconds. They can occur as single impulses or be repetitive in nature. They are believed to contribute to the anomalous behavior of electrical apparatus, typically distribution and power transformers, transmission cables, rotating machines and electronic controls. Recent efforts by DOE and others have emphasized the effects brought on by steep fronted electromagnetic waves induced by high altitude thermonuclear explosions (HEMP) on electrical systems and their associated insulating structures.

# 21 NUCLEAR POWER PLANTS

*REFER ALSO TO CITATION(S) 37593*

## 2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

*REFER ALSO TO CITATION(S) 36571, 36795, 36796, 36797, 36811, 36837, 36838, 36839, 36840, 36843, 36852, 36855, 36865, 36867, 36868, 36869, 36870, 36873, 36876, 36877, 36879, 36880, 36885, 36886, 36889, 36890, 36891, 36898, 36899, 36900, 36901, 36903, 36905, 36906, 36908, 36909, 36914, 36915, 36916, 36919, 36921, 36925, 36926, 36927, 36929, 36930, 36934*

**36772 (EPRI-NP—5150-M) Preliminary conceptual design study for a small LWR: Final report.** Duncan, J.D. (General Electric Co., San Jose, CA (USA). Nuclear Energy Business Operations; Bechtel Power Corp., San Francisco, CA (USA); Massachusetts Inst. of Tech., Cambridge (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 46p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920454.

An innovative midsized Boiling Water Reactor (MBWR) concept rated at 600 MWe is described. The MBWR features a reduced number of systems and simpler systems compared to current designs. There is virtually no reliance on active systems to perform safety functions. For example, a Gravity-Driven Core Cooling System (GDCS) and a Passive Containment Cooling System (PCCS) are employed in the MBWR. After a loss of coolant accident or other reactor inventory threatening event beyond the capability of other systems, the GDCS and PCCS keep the core covered and remove decay heat from the reactor and containment for at least three days with no operator action needed. These and other simplified safety systems as well as simplifications in the turbine island and in construction methods may result in reduced costs and substantially shortened construction periods. It is possible that the 600 MWe MBWR concept could compete economically with current higher rated plants.

**36773 (NUREG/CR—4860) Flaw density examinations of a clad boiling water reactor pressure vessel segment.** Cook, K.V.; McClung, R.W. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. Contract AC05-84OR21400. 30p. (ORNL/TM—10364). NTIS, PC A03/MF A01 - GPO. File Number TI87009373.

As part of the Oak Ridge National Laboratory's Heavy-Section Steel Technology Program, studies have been conducted to determine flaw density in a section of reactor pressure vessel cut from the Hope Creek Unit 2 vessel. This boiling water reactor vessel was never in service. One objective was to evaluate the approximate 0.7- by 3-m (2- by 10-ft) segment of the vessel provided using ultrasonic flaw detection methods performed with both ASME Code techniques and supplemental ultrasonic methods. A second objective was to evaluate the inner surface stainless steel cladding for cracks with a high sensitivity penetrant examination. Both objectives were successfully completed. Five Code-recordable indications were detected ultrasonically; however, all were found to be anomalies associated with the cladding. One flaw was detected by the supplemental ultrasonic tests, and it was analyzed destructively. This flaw was a pipeline indication, about 20 mm (0.8 in.) long extending along the length of the longitudinal weld in which it was located and was about 20 mm below the cladding surface. The flaw had a through-wall dimension (or length) of about 6 mm (0.24 in.) for an approximate 3-mm (0.1-in.) distance along the 20-mm major length. No flaws were detected by the penetrant examination of the cladding surface.

**36774 (NUREG/CR—4928) Degradation of nuclear plant temperature sensors.** Hashemian, H.M.; Peterson, K.M.; Kerlin, T.W.; Anderson, R.L.; Holbert, K.E. (Analysis and Measurement Services, Knoxville, TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1987. 80p. NTIS, PC A05/MF A01 - GPO. File Number TI87900824.

A program was established and initial tests were performed to evaluate long term performance of resistance temperature detectors (RTDs) of the type used in US nuclear power plants. The effort addressed the effect of aging on RTD calibration accuracy and response time. This Phase I effort included exposure of thirteen nuclear safety system grade RTD elements to simulated LWR temperatures. Full calibrations were performed initially and monthly, sensors were monitored and cross checked continuously during exposure, and response time tests were performed before and after exposure. Short term calibration drifts of as much as 1.8°F (1°C) were observed. Response times were essentially unaffected by this testing. This program shows that there is a sound reason for concern about the accuracy of temperature measurements in nuclear power plants. These limited tests should be expanded in a Phase II program to involve more sensors and longer exposures to simulated LWR conditions in order to obtain statistically significant data. This data is needed to establish meaningful testing or replacement intervals for safety system RTDs. An important corollary benefit from this expanded program will be a better definition of achievable accuracies in RTD calibration. This report concludes a six-month Phase I project performed for the Nuclear Regulatory Commission under the SBIR program.

36775 **Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay.** Kupperman, D.S. (Argonne National Lab., IL). pp 1707-1714 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The initiation and growth of intergranular stress-corrosion cracking in the heat-affected zone of welds in stainless steel reactor piping has been a subject of concern to electric utilities for over ten years. This type of crack can be detected with ultrasonic shear waves during normal maintenance periods with a reliability of up to 80%. Often, when crack indications have been found, the utility has been allowed to apply a weld metal overlay as a temporary repair measure. However, the complex, elastically anisotropic microstructure of the overlay considerably reduces the reliability of subsequent ultrasonic inspections. This paper addresses the problems arising because of the overlay.

36776 **Comments on remarks on the inadequacy of one-group heterogeneous theories for the interpretation of incore neutron noise in BWRs.** Difilippo, F.C. (Oak Ridge National Lab., TN). *Annals of Nuclear Energy;* **11**: No. 1-2, 89(1984). Contract W-7405-ENG-26.

In a recent paper, Analytis (1983) stated that my work in this field (Difilippo, 1982) is contradictory because either the spatial relaxation length of the local component will be overestimated, or the spatial relaxation length of the global component will be underestimated. As will be indicated below, the author partially agrees with the quoted statement but believes that, taking into consideration the main purpose of his work, there was not a contradiction.

## 2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

*REFER ALSO TO CITATION(S) 36571, 36774, 36795, 36796, 36797, 36829, 36835, 36837, 36838, 36839, 36840, 36841, 36842, 36843, 36844, 36845, 36846, 36847, 36848, 36849, 36850, 36851, 36852, 36853, 36854, 36855, 36856, 36857, 36858, 36859, 36860, 36861, 36862, 36863, 36864, 36866, 36867, 36868, 36870, 36871, 36872, 36873, 36874, 36875, 36878, 36879, 36880, 36881, 36882, 36883, 36884, 36885, 36887, 36888, 36889, 36890, 36891, 36894, 36895, 36896, 36897, 36898, 36899, 36900, 36902, 36903, 36904, 36905, 36906, 36907, 36908, 36909, 36910, 36911, 36912, 36913, 36914, 36915, 36916, 36917, 36921, 36925, 36926, 36927, 36929, 36930, 36931, 36934*

36777 **(CONF-870501—3) Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II.** Williams, M.L.; Marshall, G.M.; Chowdhury, P.; Kam, F.B.K. (Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center; Oak Ridge National Lab., TN (USA)). 31 May 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010375.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

"Standard" pressurized water reactor (PWR) calculation procedures based on two-group diffusion theory are used to compute the relative pin-power distribution in the VENUS-I and VENUS-II benchmark configurations. These two critical lattices simulate PWR cores which have fresh ($UO_2$) and burned ($MO_2$) pins on the core periphery, respectively. The purpose of the study is to establish the accuracy of these methods which are used to obtain the core source distribution for RPV fluence calculations, by comparing with the experimentally determined relative power variation. Special consideration is given to the core periphery region, which contributes most heavily to the RPV fluence.

36778 **(NUREG/CR—3231) Pipe-to-pipe impact program.** Alzheimer, J.M.; Bampton, M.C.C.; Friley, J.R.; Simonen, F.A. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. Contract AC06-76RL01830. 98p. (PNL—5779). NTIS, PC A05/MF A01 - GPO. File Number TI87010802.

The objective of this research was to determine the extent of damage that occurs when two pipes experience an impact event due to one whipping against the other. The research was conducted through experimental and analytical approaches. The former required the development of a specialized impact machine that could accelerate a whipping pipe with sufficient energy to cause failure of a target pipe that was heated and pressurized to Pressurized Water Reactor (PWR) conditions. Damage was measured in terms of crushing, bending, and failure. The results of the tests permitted the correlation between pipes of a certain size and the damage they could cause when impacting with a certain amount of known energy. These results were used to evaluate the pipe whip criteria in the Standard Review Plan 3.6.2-4. It was established that the criteria conditions did not fully represent the results obtained experimentally. An analysis procedure to model the pipe whip event was developed and used to establish the test matrix for the experimental program. This analytical procedure can also be used to predict deformation and rupture for postulated pipe whip scenarios. 17 refs.

## 2103 Power Reactors, Non-breeding, Graphite Moderated

*REFER ALSO TO CITATION(S) 36934, 37710, 37817*

36779 **(BNL—39507) Analysis of the start-up and control of a particle bed reactor.** Lazareth, O.W.; Araj, K.J.; Horn, F.L.; Ludewig, H.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-870102—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008201.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

This study describes the modeling of start-up transients in Particle Bed Reactors (PBR) for burst electric power. Two computer programs have been developed to analyze the start-up process. The first program (named KINETIC) analyzes the entire fuel element, calculating time dependent solutions for power and the temperature distribution in the packed bed. The second program (named SPHEAT, for Spherical Heating) calculates time-dependent temperatures inside individual, cladded fuel particles. The two programs provide powerful analytical tools for evaluation of material and geometrical options, power and time constraints, and conditions that could lead to element failures.

36780 **(BNL—39508) Tests of candidate materials for particle bed reactors.** Horn, F.L.; Powell, J.R.; Wales, D. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-870102—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008196.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Rhenium metal hot frits and zirconium carbide-coated fuel particles appear suitable for use in flowing hydrogen to at least 2000 K, based on previous tests. Recent tests on alternate candidate cooled particle and frit materials are described. Silicon carbide-coated particles began to react with rhenium frit material at 1600

K, forming a molten silicide at 2000 K. Silicon carbide was extensively attacked by hydrogen at 2066 K for 30 minutes, losing 3.25% of its weight. Vitrous carbon was also rapidly attacked by hydrogen at 2123 K, losing 10% of its weight in two minutes. Long term material tests on candidate materials for closed cycle helium cooled particle bed fuel elements are also described. Surface imperfections were found on the surface of pyrocarbon-coated fuel particles after ninety days exposure to flowing (~500 ppM) impure helium at 1143 K. The imperfections were superficial and did not affect particle strength.

36781 **(BNL—39509) Thermal-hydraulic considerations for particle bed reactors.** Benenati, R.; Araj, K.J.; Horn, F. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 25p. (CONF-870102—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008446.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

The physical parameters of a particle bed reactor can significantly impact performance and suitability for a particular mission. The thermal and hydraulic considerations related to these physical parameters are presented based on a conceptual reference design. Key overall assumptions and technical correlations are discussed. The importance of two design parameters, inlet frit porosity and outlet channel diameter, is demonstrated.

## 2105 Power Reactors, Breeding

*REFER ALSO TO CITATION(S) 36571, 36818, 36820, 36933, 37576*

36782 **(ANL—87-2) Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project.** Graczyk, D.G.; Hoh, J.C.; Martino, F.J.; Nelson, R.E.; Osudar, J.; Levitz, N.M. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 309p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87011236.

The technology of breeding $^{233}U$ from $^{232}Th$ in a light water reactor is being developed and evaluated by the Westinghouse Bettis Atomic Power Laboratory (BAPL) through operation and examination of the Shippingport Light Water Breeder Reactor (LWBR). Bettis is determining the end-of-life (EOL) inventory of fissile uranium in the LWBR core by nondestructive assay of a statistical sample comprising approximately 500 EOL fuel rods. This determination is being made with an irradiated-fuel assay gauge based on neutron interrogation and detection of delayed neutrons from each rod. The EOL fissile inventory will be compared with the beginning-of-life fissile loading of the LWBR to determine the extent of breeding. In support of the BAPL proof-of-breeding (POB) effort, Argonne National Laboratory (ANL) carried out destructive physical, chemical, and radiometric analyses on 17 EOL LWBR fuel rods that were previously assayed with the nondestructive gauge. The ANL work included measurements on the intact rods; shearing of the rods into pre-designated contiguous segments; separate dissolution of each of the more than 150 segments; and analysis of the dissolver solutions to determine each segment's uranium content, uranium isotopic composition, and loading of selected fission products. This report describes the facilities in which this work was carried out, details operations involved in processing each rod, and presents a comprehensive discussion of uncertainties associated with each result of the ANL measurements. Most operations were carried out remotely in shielded cells. Automated equipment and procedures, controlled by a computer system, provided error-free data acquisition and processing, as well as full replication of operations with each rod. Despite difficulties that arose during processing of a few rod segments, the ANL destructive-assay results satisfied the demanding needs of the parent LWBR-POB program.

36783 **(HEDL-SA—3491) Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials.** Lovell, A.J.; Fox, G.L.; Sutherland, W.H.; Hecht, S.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 11 Apr 1986. Contract AC06-76FF02170. 12p. (CONF-860931—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009966.

From International conference on reliable fuels for liquid metal reactors; Tucson, AZ, USA (7 Sep 1986).

The purpose of the Core Demonstration Experiment (CDE) is to demonstrate the capability of a mixed-oxide fuel system to achieve a three year life in a prototypic LMR heterogeneous reactor environment. The CDE assemblies are fabricated using wire-wrapped, large-diameter, advanced-oxide fuel and blanket pins with tempered martensitic HT9 cladding, wire wrap, and duct. The highest power fuel assembly operates with a Beginning of Life (BOL) peak linear pin power of 445 W/cm and a peak cladding temperature of 615C. The fuel and blanket assembly irradiation will start in FFTF Cycle 9 and continue for about 900 Equivalent Full Power Days (EFPD). The successful utilization of the tempered martensitic HT9 alloy in an FFTF test assembly is fully anticipated. The low swelling, observed at intermediate neutron fluence and projected to higher fluences, together with reasonable creep behavior gives acceptable mechanical performance for fuel pins, blanket pins and ducts. Duct length increase, dilation and bow; plus fuel and blanket pin diameter increases remain within specified tolerances. In addition, stress rupture data from unirradiated HT9 imply cumulative damage fractions for the nominal fuel and blanket pins that are low.

## 2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

36784 **(BNL—39697) Particle Bed Reactor scaling relationships.** Slovik, G.; Araj, K.; Horn, F.L.; Ludewig, H.; Benenati, R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 14p. (CONF-870102—25). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010062.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Scaling relationships for Particle Bed Reactors (PBRs) are discussed. The particular applications are short duration systems, i.e., for propulsion or burst power. Particle Bed Reactors can use a wide selection of different moderators and reflectors and be designed for such a wide range of power and bed power densities. Additional design considerations include the effect of varying the number of fuel elements, outlet Mach number in hot gas channel, etc. All of these variables and options result in a wide range of reactor weights and performance. Extremely light weight reactors (approximately 1 kg/MW) are possible with the appropriate choice of moderator/reflector and power density. Such systems are very attractive for propulsion systems where parasitic weight has to be minimized.

36785 **(CONF-870102—13-FP) Considerations pertinent to the Doppler effect for space reactors.** Hwang, R.N. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006986.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

This paper describes various theoretical aspects pertinent to the estimation of the Doppler effect for space reactors. The distinct characteristics of space reactors give rise to various issues that are not present in the more thoroughly studied Doppler effect of fast breeder reactors. Key issues concerning the existing resonance data and computational models are extensively discussed. Calculations of the Doppler coefficient for a generic space reactor design having features of current designs have also been carried out to illustrate various aspects of practical importance.

36786 **(CONF-870804—5) Assessment of energy storage concepts for use in pulsed space power systems.** Olszewski, M.; Morris, D.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009681.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Preliminary assessments have been completed for thermal energy storage in heat rejection systems as well as for regenerable electrical storage modules in systems having nuclear sources with

Rankine power conversion and solar sources with Brayton and Rankine power conversion. Storage technologies considered for the regenerable modules include flywheels, batteries, fuel cells, superconducting magnets and capacitors. Both source and sink thermal storage were examined for the solar energy based systems. Benefits derived from incorporating thermal storage in the heat rejection system depend on the storage density and the radiator specific mass. The analysis shows that inclusion of a thermal store results in heat rejection system mass reductions for generation times of up to 1100 seconds. Results show that the storage system value (mass reduction) increases with decreasing total generation time. In general, the value is greatest for generation times of 600 seconds or less although mass savings are realized for generation times nearly twice as long. For a total generation time of 500 seconds, incorporating storage in a nuclear Rankine power system results in a mass reduction of 50%. System masses similar to the nuclear Rankine are obtainable for solar Rankine and Brayton cycles using regenerable electrical storage modules. However, a 100-orbit recharge time is required, when the constraint of keeping concentrator areas smaller than 1000 $m^2$ is also imposed.

**36787 (DOE/NE/32117—H1) Atomic power in space: A history.** (Planning and Human Systems, Inc., Washington, DC (USA)). Mar 1987. Contract AC01-83NE32117. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010618.

"Atomic Power in Space," a history of the Space Isotope Power Program of the United States, covers the period from the program's inception in the mid-1950s through 1982. Written in nontechnical language, the history is addressed to both the general public and those more specialized in nuclear and space technologies. 19 figs., 3 tabs.

**36788 (HEDL-SA—3188) Performance of refractory alloy-clad fuel pins.** Dutt, D.S.; Cox, C.M.; Millhollen, M.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76FF02170. 26p. (CONF-850103—16). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010410.

From 2. symposium on space nuclear power systems; Albuquerque, NM, USA (14 Jan 1985).

This paper discusses objectives and basic design of two fuel-cladding tests being conducted in support of SP-100 technology development. Two of the current space nuclear power concepts use conventional pin type designs, where a coolant removes the heat from the core and transports it to an out-of-core energy conversion system. An extensive irradiation testing program was conducted in the 1950's and 1960's to develop fuel pins for space nuclear reactors. The program emphasized refractory metal clad uranium nitride (UN), uranium carbide (UC), uranium oxide ($UO_2$), and metal matrix fuels (UCZr and BeO-$UO_2$). Based on this earlier work, studies presented here show that UN and $UO_2$ fuels in conjunction with several refractory metal cladding materials demonstrated high potential for meeting space reactor requirements and that UC could serve as an alternative but higher risk fuel.

**36789 (SAND—87-0638C) RSMASS: A simple model for estimating reactor and shield masses.** Marshall, A.C.; Aragon, J.; Gallup, D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870102—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007864.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

A simple mathematical model (RSMASS) has been developed to provide rapid estimates of reactor and shield masses for space-based reactor power systems. Approximations are used rather than correlations or detailed calculations to estimate the reactor fuel mass and the masses of the moderator, structure, reflector, pressure vessel, miscellaneous components, and the reactor shield. The fuel mass is determined either by neutronics limits, thermal/hydraulic limits, or fuel damage limits, whichever yields the largest mass. RSMASS requires the reactor power and energy, 24 reactor parameters, and 20 shield parameters to be specified. This parametric approach should be applicable to a very broad range of reactor types. Reactor and shield masses calculated by RSMASS were found to be in good agreement with the masses obtained from detailed calculations.

## 2107 Regulation And Licensing

*REFER ALSO TO CITATION(S) 36806, 36833, 36835, 36836, 36929*

**36790 (NUREG—0540-Vol.9-No.2) Title list of documents made publicly available: February 1-28, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Apr 1987. 408p. NTIS, PC A18/MF A01 - GPO. File Number TI87900774.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

**36791 (NUREG—0540-Vol.9-No.4) Title list of documents made publicly available: April 1-30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jun 1987. 483p. NTIS, PC A21 - GPO. File Number DE87900839.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

**36792 (NUREG—0750-Vol.24-Index.1) Indexes to Nuclear Regulatory Commission issuances, July-September 1986.** (Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1987. 61p. NTIS, PC A04 - GPO. File Number DE87900771.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances.

**36793 (NUREG—0750-Vol.25-No.1) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jan 1987. 69p. NTIS, PC A04 - GPO. File Number DE87900854.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

**36794 (NUREG—0936-Vol.6-No.1) NRC Regulatory Agenda: Quarterly report, January-March 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). Jun 1987. 130p. NTIS, PC A07/MF A01 - GPO. File Number TI87900837.

The Regulatory Agenda is a quarterly compilation of all rules on which the NRC has proposed, or is considering action as well as those on which it has recently completed action, and all petitions for rulemaking which have been received and are pending disposition by the Commission.

36795 **(NUREG/CR—2000-Vol.6-No.1) Licensee event report (LER) compilation for month of January 1987.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Mar 1987. Contract AC05-84OR21400. 114p. (ORNL/NSIC—200-Vol.6-No.1). NTIS, PC A06/MF A01 - GPO. File Number TI87006889.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

36796 **(NUREG/CR—2000-Vol.6-No.2) Licensee event report (LER) compilation for month of February 1987.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Mar 1987. Contract AC05-84OR21400. 119p. (ORNL/NSIC—200-Vol.6-No.2). NTIS, PC A06/MF A01 - GPO. File Number TI87008297.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

36797 **(NUREG/CR—2000-Vol.6-No.4) Licensee event report (LER) compilation: For month of April 1987.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). May 1987. Contract AC05-84OR21400. 143p. (ORNL/NSIC—200-Vol.6-No.4). NTIS, PC A07/MF A01 - GPO. File Number TI87010804.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

## 2108 Economics

*REFER ALSO TO CITATION(S) 36920*

36798 **(ENEA-RT-COMB—86-1) The cost of kWh generated from nuclear stations.** Risoluti, P. (ENEA, Rome (Italy)). May 1986. 89p. (In Italian). NTIS (US Sales Only), PC A05. File Number DE87752624.

In this report the electricity generation cost from nuclear stations is calculated by the discounted cash-flow method. The CEE-Unipede discounting methodology and principles are applied, dealing with capital, operating and fuel costs for new power plants. A reference case is identified, based on core management and plant operation data set up for the standard pressurized reactors, and on updated evaluations for fuel cycle costs and projections. Back-end options with centralized storage of spent fuel and reprocessing or disposal are considered. As expected, the investment is by far the main component of the levelised discounted cost per kWh. The calculation also shows an increase influence of operating andmaintenance as well as a decreasing impact of fuel cycle costs. Back-end alternatives have a quite modest effect on the overall generating costs.

36799 **(NUREG/CR—4964) Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment.** Habegger, L.J.; Carstea, D.D.; Opelka, J.H. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1987. Contract W-31109-ENG-38. 67p. (ANL/EES-TM—332). NTIS, PC A04/MF A01 - GPO. File Number TI87010608.

In 1974, Table S-3 of the report Environmental Survey of the Uranium Fuel Cycle was published as a technical basis for consideration of the environmental effects of the uranium fuel cycle supporting operation of light-water reactors. A reference reactor cooled with light, or ordinary, water was established to reduce the burden on the Nuclear Regulatory Commission (NRC) staff, reactor license applicants, and other interested persons by removing the necessity to relitigate the environmental effects attributable to the fuel cycle, effects that are not within an applicant's control, in every individual reactor licensing proceeding. In a 1984 evaluation of a license application, it was demonstrated that the Table S-3 estimate of annual effluent of coal particulates is larger, possibly by as much as a factor of 100, than actual current values. Partially as a result of this evaluation, the NRC initiated a study to update all of the major nonradiological values in Table S-3. The results of the study are documented in this update. The report evaluates only the mining, milling, and isotopic-enrichment components of the fuel cycle's environmental parameters since these are the areas in which the greatest changes from the original study could be anticipated.

# 22 NUCLEAR REACTOR TECHNOLOGY

## 2201 Theory And Calculation

*REFER ALSO TO CITATION(S) 36922*

36800 **(SAND—86-1457C) Neutron spectrum adjustment with SANDII using arbitrary trial functions.** Kelly, J.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-870501—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010033.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

A procedure has been developed to use the SANDII spectrum adjustment code to generate satisfactory neutron spectra in a manner that does not require initial trial functions that approximate the real spectra. Thus, a spectrum can be determined primarily by a set of foil activation data, and a priori calculations of a trial spectrum or detailed knowledge about the experiment environment are not required. The reduction in the amount of information required facilitates interlaboratory comparisons and the efficiency of the spectrum generation process. Examples are provided, and a discussion is included that considers conditions under which the procedure can be expected to yield acceptable results.

## 2202 Components And Accessories

*REFER ALSO TO CITATION(S) 36823, 36827, 36828, 36831, 36918, 36922, 36932*

36801 **(CONF-860856—13) Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay.** Kupperman, D.S. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007009.

From Conference on review of progress in quantitative NDE; San Diego, CA, USA (3 Aug 1986).

The initiation and growth of intergranular stress-corrosion cracking (IGSCC) in the heat affected zone (HAZ) of stainless steel reactor piping welds has been a subject of concern to electric utilities for over ten years. This type of crack can be detected with ultrasonic shear waves during normal maintenance periods with a reliability of up to 80%. Often after an inspection indicating cracks, a utility has been allowed to administer a temporary fix to a pipe which is suspected of being cracked. This fix is a weld metal overlay. The repaired pipes often have to be inspected after the overlay has been put on the pipe. The overlay with a complex, elastically anisotropic microstructure, considerably reduces the reliability of the ultrasonic inspection. This paper addresses the problems arising because of the overlay.

36802 **(CONF-870501—4) Design and use of the Embrittlement Data Base (EDB).** Stallmann, F.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010372.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

The architecture of the Embrittlement Data Base (EDB) is described. This data base contains a comprehensive collection of experimental data related to irradiations of reactor pressure vessel steels in surveillance capsules and test reactors. Software is being developed for easy retrieval and analysis of the data. Data and software will be made available to interested parties on a cooperative basis.

36803 **(LA-UR—87-1000) Performance correlations for high temperature potassium heat pipes.** Merrigan, M.A.; Keddy, E.S.; Sena, J.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870585—2). NTIS, PC A02. File Number DE87007456.

From 6. international heat pipe conference; Grenoble, France (25 May 1987).

Potassium heat pipes designed for operation at a nominal temperature of 775K have been developed for use in a heat pipe cooled reactor design. The heat pipes operate in a gravity assist mode with a maximum required power throughput of approximately 16 kW per heat pipe. Based on a series of sub-scale experiments with 2.12 and 3.2 cm diameter heat pipes the prototypic heat pipe diameter was set at 5.7 cm with a simple knurled wall wick used in the interests of mechanical simplicity. The performance levels required for this design had been demonstrated in prior work with gutter assisted wicks and emphasis in the present work was on the attainment of similar performance with a simplified wick structure. The wick structure used in the experiment consisted of a pattern of knurled grooves in the internal wall of the heat pipe. The knurl depth required for the planned heat pipe performance was determined by scaling of wick characteristic data from the sub-scale tests. These tests indicated that the maximum performance limits of the test heat pipes did not follow normal entrainment limit predictions for textured wall gravity assist heat pipes. Test data was therefore scaled to the prototype design based on the assumption that the performance was controlled by an entrainment parameter based on the liquid flow depth in the groove structure. This correlation provided a reasonable fit to the sub-scale test data and was used in scale up of the design from the 8.0 $cm^2$ cross section of the largest sub-scale heat pipe to the 25.5 $cm^2$ cross section prototype. Correlation of the model predictions with test data from the prototype is discussed.

36804 **(NUREG/CR—4082-Vol.5) Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986.** Wilkowski, G.M.; Ahmad, J.; Barnes, C.R.; Brust, F.; Guerrieri, D.; Kiefner, J.; Kramer, G.; Kulhowvick, G.; Landow, M.; Marschall, C.W. (Battelle Columbus Div., OH (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Apr 1987. 233p. (BMI—2120-Vol.5). NTIS, PC A11/MF A01 - GPO. File Number TI87900596.

Presented herein is the Fifth Semiannual Report of the US NRC's Degraded Piping Program - Phase II. The intent of this program is to experimentally validate and enhance available analytical methods for evaluating the mechanical behavior of nuclear power plant piping containing circumferentially-oriented defects. Fifty-one pipe experiments have been conducted to date. These and approximately 42 additional pipe experiments from other programs have been analyzed. In the analytical effort, a screening criterion has been developed to show when the net-section-collapse analysis is valid. This shows that even tough materials such as stainless steel can fail at less than net-section-collapse loads if the pipe diameter is sufficiently large. Numerous predictive J-estimation schemes have been evaluated and modified. A finite length surface cracked pipe estimation scheme has also been developed. Finite element analyses of specimens with welds suggest that the size of the weld relative to the specimen or structure size can affect the deformation J values. Supporting research efforts involve investigating geometry effects on J-R curves, as well as characterizing the material properties for each pipe tested.

36805 **(NUREG/CR—4892) A study of the effects of penetration framing on steel containment buckling capacity.** Baker, W.E.; Butler, T.A. (Los Alamos National Lab., NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). May 1987. Contract W-7405-ENG-36. 50p. (LA—10977-MS). NTIS, PC A03/MF A01 - GPO. File Number TI87010786.

Polycarbonate cylinders modeling steel containment structures were tested to study the effects of different framing designs around large penetrations on the static buckling capacity of containments. Two of the four models had equipment hatch penetrations and two had personnel airlock penetrations. Both types of models were tested with axial and shear loads as framing was incrementally added. Results indicate that, for the models constructed of polycarbonate, buckling is influenced minimally with added framing. Numerical results support the experimental results. Extrapolation of the results to containment constructed under field conditions with prototypic steel materials is discussed and further testing is recommended.

36806 **(SAND—87-1091C) The identification and monitoring of critical components for nuclear life extension.** DeBey, T.M.; Carlson, D.D.; DuCharme, A.R.; Harrison, D.L. (Sandia National Labs., Albuquerque, NM (USA); USDOE, Washington, DC). 1987. Contract AC04-76DP00789. 13p. (CONF-870756—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010496.

From Symposium on aging and maintenance; Vienna, Austria (3 Jul 1987).

The US Department of Energy has a program to develop predictive performance monitoring and reliability/safety technology to enhance the operational lives of nuclear power plants. An effective equipment monitoring program can provide improved reliability and safety during a plant's initial license term, thus providing valuable data to support extending the life of a facility. Probabilistic risk assessment (PRA) techniques were initially used to help identify components that were critical to safe operation. Equipment was identified for which it is important to maintain initial reliability levels and for which it would be important to improve reliability levels. Of the equipment for which it is important to maintain initial reliability levels, three component types were further evaluated in this study: swing-check valves, motor-driven centrifugal pumps, and motor-operated valves. Component failure and degradation mechanisms were determined and then related to physical parameters and potential measurement techniques. Four types of monitoring were found to have the potential for widespread application in equipment monitoring. These are the use of ultrasonic probing, vibration monitoring, infrared emission monitoring, and acoustic emission monitoring. Efforts are continuing by the US Department of Energy, in cooperation with the US nuclear power industry, to develop specific monitoring techniques.

36807 **(RFP-Trans—465) System for removing contaminated surface layers.** Yoshikawa, Kozo. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Mitsubishi Jukogyo K.K., Tokyo (Japan)). Apr 1987. Contract AC04-76DP03533. Translation of Japanese Patent No. Sho 1983-158,599. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008183.

The object of the present invention is to offer a new type of useful decontamination system, with which the contaminated surface layers can be removed effectively by injection of such solid microparticles. Liquid carbon dioxide is passed from a liquid carbon dioxide tank via the carbon dioxide supply line into the system for injecting solid carbon dioxide particles. Part of the liquid carbon dioxide introduced into the system is converted to solid carbon dioxide particles by the temperature drop resulting from adiabatic expansion in the carbon dioxide expansion space of the injection system. The solid carbon dioxide particles reach the injection nozzle, which is connected through the expansion space. The carbon dioxide microparticles are further cooled and accelerated by nitrogen gas injected from the nitrogen gas nozzle at the tip of the nitrogen gas supply line, which is connected to a liquid nitrogen tank. The cooled and accelerated solid carbon dioxide microparticles are injected from the injection nozzle for the solid carbon dioxide and directed against the contaminated surface to be cleaned, and, as a result, the surface contamination is removed.

36808 **3-D world modeling based on combinatorial geometry for autonomous robot navigation.** Goldstein, M.; Pin, F.G.; De Saussure, G.; Weisbin, C.R. (Center for Engineering Systems Advanced Research, Oak Ridge National Lab., Oak Ridge, TN 37831). pp 727-733 of IEEE international conference on robotics and automation. Piscataway, NJ; IEEE Service Center (1987). (CONF-870354—).

From IEEE international conference on robotics and automation; Raleigh, NC, USA (30 Mar 1987).

In applications of robotics to surveillance and mapping at nuclear facilities the scene to be described is three-dimensional. Using range data a 3-D model of the environment can be built. First, each measured point on the object surface is surrounded by a solid sphere with a radius determined by the range to that point. Then the 3-D shapes of the visible surfaces are obtained by taking the (Boolean) union of the spheres. Using this representation distances to boundary surfaces can be efficiently calculated. This feature is particularly useful for navigation purposes. The efficiency of the proposed approach is illustrated by a simulation of a spherical robot navigating in a 3-D room with static obstacles.

## 2203 Fuel Elements

*REFER ALSO TO CITATION(S) 36815*

36809 **(GKSS—86/E/57) Agreement of model investigations of the critical heat flux in fuel element clusters.** Katsaounis, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1986. 30p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06347.

Two dimensionless numbers have been developed for the fluid scaling law of the boiling crisis in bubble flow regime (film boiling) Z′ and in annular flow regime (dryout) Z″. Both numbers have been compared with the dimensionless numbers of Ahmad. All dimensionless numbers have been verified with boiling crisis data performed in 6 rodbundle test sections. The Ahmad number gives satisfactory results at mass flow rates higher than 1000 kg/m/ sup 2/s. The dimensionless number Z″ yields an increased agreement, while Z′ can only be used satisfactorily for data at high mass fluxes and low steam qualities. Furthermore, the spacers have similar influence on CHF in freon 12 and water tests.

36810 **(UNI-SA—166) Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements.** Spanner, G.E.; Eick, J.L. (UNC Nuclear Industries, Inc., Richland, WA (USA); Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830;AC06-76RL01857. 8p. (PNL-SA—13792; CONF-8611147—1). NTIS MF A01; 2; GPO Dep. File Number DE87007840.

From 8. international conference on NDE in the nuclear industry; Orlando, FL, USA (17 Nov 1986).

At the request of UNC Nuclear Industries, the Pacific Northwest Laboratory designed and fabricated a nondestructive inspection system for assessing the quality of tubular nuclear fuel elements. The system simultaneously uses (1) multifrequency eddy currents to measure the thickness of zircaloy cladding and (2) ultrasonic through-transmission tests to assess the quality of the bond between the zircaloy and the uranium core. Inspection of the inside and outside surfaces of the fuel elements is also simultaneous. Fuel elements are first automatically loaded into the system's testing area; then the inspections proceed entirely under microprocessor control. Inspection results are printed by a digital strip chart recorder that automatically scales the results and prints descriptions of the recorded tests. The eddy current subsystem that measures the zircaloy cladding thickness has several novel features. Two concentric coils, one operated at 50 kHz and the other at 5 MHz, make up each eddy current probe. The impedance signals from these two frequencies are digitized and combined to compensate for the effects of varying liftoff (the distance between the probe and the inspected piece). Fluid bearings are used to support the probes a small distance from the test piece.

## 2204 Control Systems

*REFER ALSO TO CITATION(S) 36934*

36811 **(BNL-NUREG—39849) Emergency response training with the BNL plant analyzer.** Cheng, H.S.; Guppy, J.G.; Mallen, A.N.; Wulff, W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870418—4). NTIS, PC A02/MF A01 - GPO. File Number TI87010755.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

Presented is the experience in the use of the BNL Plant Analyzer for NRC emergency response training to simulated accidents in a BWR. The unique features of the BNL Plant Analyzer that are important for the emergency response training are summarized. A

closed-loop simulation of all the key systems of a power plant in question was found essential to the realism of the emergency drills conducted at NRC. The faster than real-time simulation speeds afforded by the BNL Plant Analyzer have demonstrated its usefulness for the timely conduct of the emergency response training.

36812 **(DOE/NE/37959—2) Signal validation in nuclear power plants: Progress report No. 1.** Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 29 Dec 1986. Contract AC02-86NE37959. 6p. NTIS, PC A02. File Number DE87010679.

This report summarizes the progress in the development of signal validation modules, the general architecture of implementation, and a brief description of two of the modules. The primary goal of the project is to develop a signal validation system for validating signals channeled to control systems, safety systems and display systems in nuclear power plants. The signal validation system consists of modules that evaluate the sensor outputs for the validity compared to desired performance, and for unusual characteristics from normal behavior.

36813 **(DOE/NE/37959—3) Signal validation in nuclear power plants: Progress report No. 2.** Kerlin, T.W.; Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 25 Mar 1987. Contract AC02-86NE37959. 7p. NTIS, PC A02. File Number DE87010680.

This report summarizes the progress in the development of several signal validation modules and the results of preliminary implementation. A description of the system modules is provided as well as a listing of future research projects.

36814 **(EPRI-NP—4696-CCM-Vol.2) IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0.** Horne, C.P. (Horne (Charles P.), Inc., Orinda, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 58p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920348.

The EPRI Information Monitoring and Applied Graphics Environment (IMAGE) system is designed for 'fast proto-typing' of advanced concepts for computer-aided plant operations tools. It is a flexible software system which can be used for rapidly creating, dynamically driving and evaluating advanced operator aid displays. The software is written to be both host computer and graphic device independent. The advent of microcomputer colorgraphics capability has greatly expanded the base of utility users of who want to build and apply dynamic colorgraphics displays. The IBM-PC version of the IMAGE package has been developed in response to the growing needs. The form and structure of the IBM-PC version is generally the same as host resident IMAGE (c.f., NP-4758-CCM) allowing users to translate display files between the two.

36815 **(HEDL-SA—3359) CLEO: A knowledge-based refueling assistant at FFTF.** Smith, D.E.; Kocher, L.F.; Seeman, S.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1985. Contract AC06-76FF02170. 7p. (CONF-851115—54). NTIS, PC A02. File Number DE87010411.

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

CLEO is computer software system to assist in the planning and performance of the reactor refueling operations at the Fast Flux Test Facility. It is a recently developed application of artificial intelligence software with both expert systems and automated reasoning aspects. The computer system seeks to organize the sequence of core component movements according to the rules and logic used by the expert. In this form, CLEO has aspects which tie it to both the expert systems and automated reasoning areas within the artificial intelligence field.

## 2205 Environmental Aspects

*REFER ALSO TO CITATION(S) 36555, 36824, 36928, 37711, 37722*

36816 **(UNI—3760) UNC environmental surveillance report for the 100 areas: FY 1985.** Jacques, I.D. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 27 Feb 1986. Contract AC06-76RL01857. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008414.

Results from the UNC Environmental Surveillance Program for the Hanford 100 Areas are discussed in this report. The surveillance program provides sampling and monitoring of several parameters in order to evaluate the environmental impact of 100-N Reactor facilities and the shutdown reactor facilities and burial grounds in the retired 100 Areas. At 100-N Area, samples of ambient air, ground water, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the operation and impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDF). Direct radiation surveys were also conducted for each of the facilities. At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from ground-water monitoring wells located at 100-K Area were collected and analyzed. Special samples collected during the fiscal year are also included in the appropriate sections of the report.

36817 **(UNI—4065) UNC environmental surveillance report for the 100 areas: FY 1986.** Jacques, I.D. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 12 Jan 1987. Contract AC06-76RL01857. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008413.

Results from the UNC Environmental Surveillance Program for the Hanford 100 Areas are presented in this report. The surveillance program provides sampling and monitoring of several parameters in order to evaluate the environmental impact of 100-N Area Reactor facilities and the shutdown reactor facilities and burial grounds in the retired 100 Areas. At 100-N Area, samples of ambient air, ground water, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the environmental impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDF). Direct radiation surveys were conducted for each LWDF and along the Columbia River shoreline. At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from ground-water monitoring wells located at 100-K Area were collected and analyzed.

## 2206 Research, Test, And Experimental Reactors

*REFER ALSO TO CITATION(S) 36777, 36815, 36824*

36818 **(CONF-861102—35) Validation of an intermediate heat exchanger model for real time analysis.** Tzanos, C.P. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004743.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

A new method was presented for LMFBR intermediate heat exchanger (IHX) analysis in real time for purposes of continuous on-line data validation, plant state verification and fault identification. For the validation of this methodology the EBR-II IHX transient during Test 8A was analyzed. This paper presents the results of this analysis.

36819 **(DOE/ER/75173—1) Nuclear reactor and materials science research: Final technical report, May 1, 1985-September 30, 1986.** Harling, O.K. (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). 11 May 1987. Contract FG02-85ER75173. 12p. (MITNRL—022). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010406.

Throughout the 17-month period of the grant, May 1, 1985 - September 30, 1986, the MIT Research Reactor (MITR-II) was operated in support of research and academic programs in the physical and life sciences and in related engineering fields. The period encompassed MIT's fiscal year utilization of the reactor during that period may be classified as follows: neutron beam tube research, nuclear materials research and development, radiochemistry and trace analysis, nuclear medicine, radiation health physics, computer control of reactors, dose reduction in nuclear power reactors, reactor irradiations and services for groups outside MIT, and MIT research reactor. This paper provides detailed information on this research academic utilization.

**36820 (HEDL-SA—3349) Transient survivability of LMR oxide fuel pins.** Weber, E.T.; Pitner, A.L.; Bard, F.E.; Culley, G.E.; Hunter, C.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 25 Mar 1986. Contract AC06-76FF02170. 7p. (CONF-860501—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009972.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

Fuel pin integrity during transient events must be assessed for both the core design and safety analysis phases of a reactor project. A significant increase in the experience related to limits of integrity for oxide fuel pins in transient overpower events has been realized from testing of fuel pins irradiated in FFTF and PFR. Fourteen FFTF irradiated fuel pins were tested in TREAT, representing a range of burnups, overpower ramp rates and maximum overpower conditions. Results of these tests along with similar testing in the PFR/TREAT program, provide a demonstration of significant safety margins for oxide fuel pins. Useful information applied in analytical extrapolation of fuel pin test data have been developed from laboratory transient tests on irradiated fuel cladding (FCTT) and on unirradiated fuel pellet deformation. These refinements in oxide fuel transient performance are being applied in assessment of transient capabilities of long lifetime fuel designs using ferritic cladding.

## 2207 Plutonium And Isotope Production Reactors

*REFER ALSO TO CITATION(S) 36796, 36816, 36817*

## 2208 Propulsion Reactors

*REFER ALSO TO CITATION(S) 36784*

**36821 (LA—10625-MS-Rev.) Low-thrust rocket trajectories.** Keaton, P.W. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006307.

The development of low-thrust propulsion systems to complement chemical propulsion systems will greatly enhance the evolution of future space programs. Two advantages of low-thrust rockets are stressed: first, in a strong gravitational field, such as occurs near the Earth, freighter missions with low-thrust engines require one-tenth as much propellant as do chemical engines. Second, in a weak gravitational field, such as occurs in the region between Venus and Mars, low-thrust rockets are faster than chemical rockets with comparable propellant mass. The purpose here is to address the physics of low-thrust trajectories and to interpret the results with two simple models. Analytic analyses are used where possible - otherwise, the results of numerical calculations are presented in graphs. The author has attempted to make this a self-contained report.

## 2209 Reactor Safety

*REFER ALSO TO CITATION(S) 36558, 36795, 37817, 38291*

**36822 (BMU—1986-134) Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor.** Langer, G.; Schimetschka, E. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). 1986. 112p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-04720.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This status report discusses the countermeasures 'deliberate ignition' and 'halon-inerting' which had been selected for further investigation in phase II of this project. For both measures several questions remain to be answered in order to achieve the overall goal of the project. This overall goal is to develop and substantiate basic information as to whether or not a certain countermeasure should be recommended for PWRs of German design. For the two countermeasures considered here, draft concepts for application in a standard PWR have been develop to assess the technical aspects of both systems. Most of the open questions could be answered. Those aspects which could not be completely clarified in this phase have been assessed as to their safety-related importance by evaluating the results of theoretical and experimental investigations currently under way in the USA. The most important results of our research in 1983 may be summarized as follows: Halon inerting will not be considered further because this possible hydrogen control measure involves the risk of inadvertant initiation during normal operation and because of the corrosion problem which may arise after inadvertant initiation and after intentional use during an accident. As to deliberate ignition, questions still remain to be answered with respect to its functional reliability under accident conditions and with respect to the 'survivability' problem.

**36823 (BNL-NUREG—39134) Plant lifetime reliability and risk: Addressing today's strategies for making tomorrow's decisions.** Boccio, J.L. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 25p. (CONF-8611106—1). NTIS MF A01. File Number TI87005258.

From Brookhaven National Laboratory regional utilities seminar life extension, energy/fuels and environment; Upton, NY, USA (5 Nov 1986).

This paper presents an overview of some of the research projects, conducted for the US Nuclear Regulatory Commission (NRC) that deal with the question: How can an acceptable level of risk of a nuclear power plant be maintained throughout its design life? With a viewpoint that life extension planning for a plant can be viewed as a long-range, strategic maintenance program, the products of this research are discussed from the perspective of being elements that can tie day-to-day, plant operational tactical decisions on component/system reliability with long-range strategic maintenance goals. A common factor in addressing issues associated with design life and life extension is the issue of component aging and the reliability implications of aging. A time-dependent reliability model is described which contains some of the requisite ingredients and is built on a framework from which the component aging/component reliability issue can be addressed. By way of select examples, the additional work needed to further address plant lifetime reliability and risk is indicated.

**36824 (CONF-861204—9) Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions.** Schlenger, B.J.; Horton, E.L.; Herceg, J.E.; Dunn, P.F. (Argonne National Lab., IL (USA); Notre Dame Univ., IN (USA)). Dec 1986. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010646.

From 4. Miami international symposium on multi-phase transport and particulate phenomena; Miami Beach, FL, USA (15 Dec 1986).

An aerosol sampling system was designed and used in a series of nuclear reactor safety experiments. The system was de-

signed to sample radioactive and chemically reactive aerosols of unknown size distributions and concentrations in high temperature, high pressure steam/hydrogen environments. The aerosol samples are being analyzed posttest to determine their composition and morphology by microanalytical techniques. Main steam particle size distributions and loadings are being computed from particle data generated from SEM micrograph images and collection efficiencies calculated with measured thermal-hydraulic data. The system would be applicable to other types of experiments in which the sampling environment is severe and/or a priori knowledge of the general particle size range and loading are limited.

36825 **(DP-MS—87-49) Using operating experience and a cause coding tree to identify improvements for nuclear process control.** Paradies, M.W.; Busch, D.A. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 16p. (CONF-870768—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011183.

From Mid-central ergonomics/human factors conference; Champaign, IL, USA (15 Jul 1987).

This paper outlines a systematic approach to identification of the root causes of incidents and the use of that information to improve nuclear plant process control. The paper describes how the system was developed, how the system is used, and how the system has been accepted.

36826 **(EPRI-NP—5054-SR) Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions.** Ritzman, R.L. (Comp.). (Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 415p. (CONF-8609126—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Separates abstracts were prepared for the individual papers in this report. (JDB)

36827 **(EPRI-NP—5228-Vol.1) Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report.** Czarnecki, R.M. (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 228p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920456.

Guidelines have been developed to evaluate the seismic adequacy of the anchorage of various classes of electrical and mechanical equipment in nuclear power plants covered by NRC Unresolved Safety Issue A-46. The guidelines consist of screening tables that give the seismic anchorage capacity as a function of key equipment and anchorage fasteners, inspection checklists for field verification of anchorage adequacy, and provisions for outliers that can be used to further investigate anchorages that cannot be verified in the field. The screening tables are based on an analysis of the anchorage forces developed by common equipment types and on strength criteria to quantify the holding power of anchor bolts and welds. The strength criteria for expansion anchor bolts were developed by collecting and analyzing a large quantity of test data.

36828 **(EPRI-NP—5228-Vol.2) Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report.** Czarnecki, R.M. (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 83p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920455.

Guidelines have been developed to evaluate the seismic adequacy of the anchorage of various classes of electrical and mechanical equipment in nuclear power plants covered by NRC Unresolved Safety Issue A-46. The guidelines consist of screening tables that give the seismic anchorage capacity as a function of key equipment and anchorage fasteners, inspection checklists for field verification of anchorage adequacy, and provisions for outliers that can be used to further investigate anchorages that cannot be verified in the field. The screening tables are based on an analysis of the anchorage forces developed by common equipment types and on strength criteria to quantify the holding power of anchor bolts and welds. The strength criteria for expansion anchor bolts were developed by collecting and analyzing a large quantity of test data.

36829 **(GEND—061) Lessons learned from hydrogen generation and burning during the TMI-2 event.** Henrie, J.O.; Postma, A.K. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-77RL01030. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010696.

This document summarizes what has been learned from generation of hydrogen in the reactor core and the hydrogen burn that occurred in the containment building of the Three Mile Island Unit No. 2 (TMI-2) nuclear power plant on March 28, 1979. During the TMI-2 loss-of-coolant accident (LOCA), a large quantity of hydrogen was generated by a zirconium-water reaction. The hydrogen burn that occurred 9 h and 50 min after the initiation of the TMI-2 accident went essentially unnoticed for the first few days. Even through the burn increased the containment gas temperature and pressure to 1200°F (650°C) and 29 lb/in² (200 kPa) gage, there was no serious threat to the containment building. The processes, rates, and quantities of hydrogen gas generated and removed during and following the LOCA are described in this report. In addition, the methods which were used to define the conditions that existed in the containment building before, during, and after the hydrogen burn are described. The results of data evaluations and engineering calculations are presented to show the pressure and temperature histories of the atmosphere in various containment segments during and after the burn. Material and equipment in reactor containment buildings can be protected from burn damage by the use of relatively simple enclosures or insulation.

36830 **(GRS-F—155) List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: October 1-December 31, 1986. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Feb 1987. 44p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-07018.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programm of the BMFT, reporting organization. The list of reports appears quarterly.

36831 **(HEDL-SA—3629) Comparison of a quasistatic seismic strain range method with test and detailed transient analysis.** Weiner, E.O.; Peters, K.A.;; Busch, K.A. (Hanford Engineering Development Lab., Richland, WA (USA); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). Mar 1987. Contract AC06-76FF02170. 8p. (CONF-870636—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009967.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

A recently developed method for estimating the maximum strain range of a structure subject to seismic excitation has been applied to a one inch pipe test configuration. The method uses the concept of a simple substitute structure with physical constants developed from quasistatic plastic analysis of the full structure. Loads for the quasistatic analysis are model loads gradually scaled to cover strain levels of interest. The substitute, subjected to the same excitation as the structure, represents the structure's important characteristics of strain concentration, structural system hardening and hysteretic damping. From test data, maximum strain ranges from 0.5% to 1.0% were obtained for four levels of strong sinusoidal shaking. The quasistatic method gave conservative predictions

at all levels, on an average by about 30% of the test results. Reapplication of the method to detailed transient analyses of the same piping configuration also gave conservative results.

36832 (LMF—115, pp 3-8) **Characteristics of radioactive particles released from the Chernobyl nuclear reactor.** Cuddihy, R.G.; Finch, G.L.; Newton, G.J.; Hahn, F.F.; Mewhinney, J.A.; Rothenberg, S.J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

A sample of radioactive particles that were released in the Chernobyl nuclear reactor accident and deposited on a nearby wood surface was analyzed. Energy dispersive X-ray analysis showed the chemical composition of different particles to be either uranium, cerium and lanthanum, or zirconium. The latter two types of particles also contained aluminum, silicon, calcium, phosphorus, and chlorine that were probably derived from high-temperature interactions of fuel with concrete and steel structures of the reactor. The major gamma-emitting radionuclides associated with the particles are $^{95}Zr$-$^{95}Nb$, $^{103}Ru$, $^{106}Ru$-$^{106}Rh$, $^{134}Cs$, $^{137}Cs$, $^{141}Ce$, and $^{144}Ce$-$^{144}Pr$. When selected particle samples were placed in aqueous media, all radionuclides were slow to dissolve, showing an average dissolution half-time of about 160 days. The particle samples studied die not contain the radionuclides, $^{131}I$ or $^{140}Ba$-$^{140}La$, which were frequently reported as being abundant in samples collected at more distant locations throughout Europe. The authors concluded that if these particles were inhaled by people near the reactor site, the largest portion of the radiation dose would be delivered to lung tissue. 8 references, 5 figures.

36833 (NUREG—0728-Rev.2) **NRC Incident Response Plan.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jun 1987. 27p. NTIS, PC A03/MF A01 - GPO. File Number TI87900776.

The Nuclear Regulatory Commission (NRC) regulates civilian nuclear activities to protect the public health and safety and to preserve environmental quality. An Incident Response Plan had been developed and has now been revised to reflect current Commission policy. NUREG-0728, Rev. 2 assigns responsibilities for responding to any potentially threatening incident involving NRC licensed activities and for assuring that the NRC will fulfill it statutory mission. This report has also been reproduced for staff use as NRC Manual Chapter 0502.

36834 (NUREG—1147-Rev.1) **Seismic safety research program plan.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 240p. NTIS, PC A11/MF A01 - GPO. File Number TI87900813.

This document presents a plan for seismic research to be performed by the Structural and Seismic Engineering Branch in the Office of Nuclear Regulatory Research. The plan describes the regulatory needs and related research necessary to address the following issues: uncertainties in seismic hazard, earthquakes larger than the design basis, seismic vulnerabilities, shifts in building frequency, piping design, and the adequacy of current criteria and methods. In addition to presenting current and proposed research within the NRC, the plan discusses research sponsored by other domestic and foreign sources.

36835 (NUREG—1259) **Technical Specifications, Beaver Valley Power Station, Unit No. 2 (Docket No. 50-412): Appendix A to License No. NPF-64.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1987. 427p. NTIS, PC A19/MF A01 - GPO. File Number TI87900762.

Information is presented for Beaver Valley-2 Reactor for the areas of safety limits, limiting safety system settings, limiting conditions for operating and surveillance requirements, design features, and administrative control. (FI)

36836 (NUREG—1272) **Report to the US Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data, 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). May 1987. 247p. NTIS, PC A11/MF A01 - GPO. File Number TI87900765.

This annual report of the US Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) is devoted to the activities performed during calendar year 1986. Comments and observations are provided on operating experience at nuclear power plants and other NRC licensees, including results from selected AEOD studies; summaries of abnormal occurrences involving US nuclear plants; reviews of licensee event reports and their quality, reactor scram experience from 1984 to 1986, engineered safety features actuations, and the trends and patterns analysis program; and assessments of nonreactor and medical misadministration events. In addition, the report provides the year-end status of all recommendations included in AEOD studies, and listings of all AEOD reports issued from 1980 through 1986.

36837 (NUREG/CP—0082-Vol.4, pp 1-8) **Revision of the ECCS rule.** Beckner, W.D.; Reyes, J.N. Jr. (Nuclear Regulatory Commission). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The US Nuclear Regulatory Commission (NRC) staff has proposed a revision to the ECCS rule contained in 10 CFR 50.46 and Appendix K based upon a decade of research on ECCS performance. The rule change is expected to provide more realistic and technically defensible regulation and has the potential to provide significant economic benefit.

36838 (NUREG/CP—0082-Vol.4, pp 9-10) **Regulatory guide in support of ECCS rule revision.** Tovmassian, H.S. Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The US Nuclear Regulatory Commission staff is proposing to amend 10 CFR 50.46 and Appendix K to allow licensees to use best estimate calculations to estimate emergency core cooling system performance. This estimate in conjunction with an estimate of the uncertainty in the calculation would then be used to assure that the licensing limits set forth in 10 CFR 50.46(b) are not exceeded. The NRC staff has prepared a draft regulatory guide to assist licensees and applicants in complying with these proposed amendments. This paper sets forth the objectives of this regulatory guide, the approach taken, the difficulties encountered, and the current status of this effort.

36839 (NUREG/CP—0082-Vol.4, pp 11-26) **Experience with the revised Appendix K.** Sheron, B.W.; Hsii, Y.G. Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In 1983, during the course of reviewing proposed ECCS evaluation methods by General Electric, the NRC staff developed an approach to ECCS analysis which allowed for the systematic reduction of excessive margin. The staff has approved this methodology for one vendor, and is in the process of approving a methodology for another vendor. Experiences in licensing models to this new methodology are summarized in this paper.

36840 (NUREG/CP—0082-Vol.4, pp 27-30) **Status of integral facilities and future plans for integral testing.** Solberg, D.E. Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An overview is presented of large scale and integral systems experimental programs of interest to the Nuclear Regulatory Commission. The FIST facility for BWR systems experiments and the Semiscale and LOFT facilities for PWR systems experiments, the ROSA IV facility in Japan, the Multiloop Integral System Test (MIST) facility and the University of Maryland facilities are noted.

Plans for future experimental facilities directed toward Babcock and Wilcox plant responses are addressed.

36841 (NUREG/CP—0082-Vol.4, pp 31-52) **Evaluation of scaling concepts for integral system test facilities.** Condie, K.G.; Larson, T.K. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.4). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A study was conducted by EG & G Idaho, Inc., to identify and technically evaluate potential concepts which will allow the US Nuclear Regulatory Commission to maintain the capability to conduct future integral, thermal-hydraulic facility experiments of interest to light water reactor safety. This paper summarizes the methodology used in the study and presents rankings for each facility concept relative to its ability to simulate phenomena identified as important in selected reactor transients in Babcock & Wilcox and Westinghouse large pressurized water reactors. Established scaling methodologies are used to develop potential concepts for scaled integral thermal-hydraulic experiment facilities. Concepts selected included: full height, full pressure water; reduced height, reduced pressure water; reduced height, full pressure water; one-tenth linear, full pressure water; and reduced height, full scaled pressure Freon. Results from this study suggest that a facility capable of operating at typical reactor operating conditions will scale most phenomena reasonably well. Local heat transfer phenomena is best scaled by the full height facility while the reduced height facilities provide better scaling where multi-dimensional phenomena are considered important.

36842 (NUREG/CP—0082-Vol.4, pp 53-64) **PWR recovery procedures investigated in the LOBI-MOD2 test facility.** Addabbo, C.; Piplies, L. (Commission of the European Communities, Ispra, Italy). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

LOBI-MOD2 test results of interest for the analysis of prospected PWR recovery procedures are presented. They relate: (1) to the efficiency of the secondary system as an additional heat sink in small break LOCAs, (2) to the recovery of the secondary system heat sink from highly degraded conditions, (3) to potential long term cooldown via primary system bleed and feed and (4) to primary system depressurization using the pressurizer cooling system. The reported experimental results provide a basis for the understanding of underlying phenomena and a reference for the development and the assessment of analytical tools used in PWR safety analysis.

36843 (NUREG/CP—0082-Vol.4, pp 65-86) **PKL III small breaks and transients experimental program.** Mandl, R.M.; Brand, B. (Kraftwerk Union AG, Erlangen, West Germany). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Operational experience as well as risk studies show the probability of a small break being greater by several orders of magnitude than a double-ended break of a primary coolant pipe. Therefore the next test series to be carried out in the PKL test facility will cover small breaks and operational transients. A scaling and feasibility study was carried out as a result of which changes to the test facility were proposed. The program objectives, modification to the facility, scope of tests to be carried out as well as the schedule are described in this article.

36844 (NUREG/CP—0082-Vol.4, pp 87-112) **Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility.** Carter, H.R.; Gloudemans, J.R. (Babcock & Wilcox Co., Alliance, OH). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Multiloop Integral System Test (MIST) is part of a multiphase program started in 1983 to address small-break loss-of-coolant accidents (SBLOCAs) specific to Babcock & Wilcox-designed plants. MIST is sponsored by the US Nuclear Regulatory Commission, the Babcock & Wilcox Owners Group, Electric Power Research Institute, and Babcock & Wilcox. The unique features of the Babcock & Wilcox (B & W) design - specifically the hot leg U-bends and steam generators - prevented the use of existing integral system data or existing integral system facilities to address the thermal-hydraulic SBLOCA questions. MIST and two other supporting facilities (1) were specifically designed and constructed for this program, and an existing facility - the Once-Through Integral System (OTIS) was also used. Data from MIST and the other facilities will be used to benchmark the adequacy of system codes, such as RELAP-5 and TRAC, for predicting abnormal plant transients. The MIST facility design, transient test matrix, and results from three transient tests are described.

36845 (NUREG/CP—0082-Vol.4, pp 113-132) **TRAC-PF1/MOD1 pretest predictions of MIST experiments.** Boyack, B.E.; Steiner, J.L.; Siebe, D.A. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Los Alamos National Laboratory is a participant in the Integral System Test (IST) program initiated in June 1983 to provide integral system test data on specific issues and phenomena relevant to post small-break loss-of-coolant accidents (SBLOCAs) in Babcock & Wilcox plant designs. The Multi-Loop Integral System Test (MIST) facility is the largest single component in the IST program. During Fiscal Year 1986, Los Alamos performed five MIST pretest analyses. The five experiments were chosen on the basis of their potential either to approach the facility limits or to challenge the predictive capability of the TRAC-PF1/MOD1 code. Three SBLOCA tests were examined which included nominal test conditions, throttled auxiliary feedwater and asymmetric steam-generator cooldown, and reduced high-pressure-injection (HPI) capacity, respectively. Also analyzed were two feed-and-bleed cooling tests with reduced HPI and delayed HPI initiation. Results of the tests showed that the MIST facility limits would not be approached in the five tests considered. Early comparisons with preliminary test data indicate that the TRAC-PF1/MOD1 code is correctly calculating the dominant phenomena occurring in the MIST facility during the tests. Post-test analyses are planned to provide a quantitative assessment of the code's ability to predict MIST transients.

36846 (NUREG/CP—0082-Vol.4, pp 133-150) **Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system.** Almenas, K.; Di Marzo, M.; Hsu, Y.Y.; Massoud, M.; Shieh, S.; Wang, Z.Y.; Munno, C.J.; Heper, H.; Munno, F.J.; Pertmer, G.A. (Univ. of Maryland, College Park). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The University of Maryland at College Park 2 x 4 Loop has been operational since 1985. During the last year, many single-phase natural circulation tests were conducted. After the single-phase test series were completed, the facility was modified to allow for better instrumentation, for addition of cold-leg orifices simulating pump resistances, and for finer control of secondary flow rates. Since then, various phases of the transient (single-phase, two-phase, and boiling condensation mode) related to a small break loss-of-coolant accident (SBLOCA) have been conducted. In this report, the salient features of single-phase natural circulation, two-phase natural circulation, and boiling condensation mode test results are presented and the observed phenomena at the UMCP 2 x 4 Loop are discussed.

36847 (NUREG/CP—0082-Vol.4, pp 151-176) **Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests.** Streit, J.E. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.4). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Inadequate core cooling conditions can result in small break loss-of-coolant accidents (SBLOCAs) without high pressure injection unless appropriate operator action is taken. Results from the S-

NH test series, performed in the Semiscale Mod-2C facility, show that for SBLOCAs below 2.1% inadequate core cooling results before the accumulator actuation pressure is reached. Various recovery operations were used in the experiments in the S-NH test series to mitigate the heater rod temperature excursions and lower the primary system pressure to the accumulator actuation pressure. These recovery operations included steam generator secondary steam-and-feed and primary coolant pump restart. In addition, in one of the experiments steam generator secondary steam-and-feed operations were begun before a heater rod temperature excursion began. The effectiveness each procedure had in mitigating the heater rod temperature excursions is discussed and compared.

36848 (NUREG/CP—0082-Vol.4, pp 177-198) **Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF.** Tasaka, K.; Kukita, Y.; Koizumi, Y.; Osakabe, M.; Nakamura, H. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The ROSA-IV Program at the Japan Atomic Energy Research Institute is conducting integral simulation experiments on pressurized water reactor small-break loss-of-coolant accidents and operational transients using the Large Scale Test Facility. The present paper summarizes results from several recent LSTF experiments which investigated the test parameter influences on 5%-break LOCA transients, as well as single-phase and two-phase natural circulation phenomena under steady-state conditions.

36849 (NUREG/CP—0082-Vol.4, pp 199-224) **Comparison of a TRAC calculation to the data from LSTF run SB-CL-05.** Motley, F.; Schultz, R. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Run SB-CL-05 is a 5% break in the side of the cold leg. The test results show that the core was uncovered briefly and that the rods overheated at certain core locations. Liquid holdup on the upflow side of the steam generator tubes was observed. When the loop seal cleared, the core refilled and the rods cooled. The TRAC results are in reasonable agreement with the test data, meaning that TRAC correctly predicted the major trends and phenomena. TRAC predicted the core uncovery, the resulting rod heatup, and the liquid holdup on the upflow side of the steam generator tubes correctly. The clearing of the loop seal allowed core recovery and cooled the overheated rods just as it had in the data, but TRAC predicted its occurrence 20 s late. The experimental and TRAC analysis results of run SB-CL-05 are similar to those for Semiscale Run S-UT-8. In both runs there was core uncovery, rod overheating, and steam generator liquid holdup. These results confirm scaling of these phenomena from Semiscale (1/1650) to LSTF (1/48).

36850 (NUREG/CP—0082-Vol.4, pp 225-240) **Management of emergency feedwater during natural circulation cooldown following a loss of offsite power scenario.** Davidson, E.H.; Stutzke, M.A. (Florida Power Corp., St. Petersburg). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

As the result of calculations performed at Florida Power Corporation during 1986, a better appreciation has been obtained of the flexibility and the limitations associated with managing emergency feedwater (EFW) inventory while providing emergency cooling to pressurized water reactors. This insight was gained while investigating the EFW inventory requirement following a loss of offsite power scenario. In general, an operator may (1) use a wide range of cooldown rates and (2) wait several hours before initiating a cooldown without significantly varying the total amount of EFW required to complete a cooldown. Although the studies performed were related to the specific conditions of the Crystal River 3 Nuclear Generating Station, the authors believe that the information gained is generically applicable to pressurized water reactors under conditions where the atmospheric dump valves limit the time to cooldown.

36851 (NUREG/CP—0082-Vol.4, pp 241-264) **Two-phase flow measurement in the upper plenum of a PWR during reflood.** Griffith, P.; Gawlik, K. (Massachusetts Institute of Technology, Cambridge). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In order to study the two-phase hydrodynamics of a pressurized water reactor during emergency reflood, a group of four instruments has been developed for installation at the core and upper plenum interface. These instruments are a drag body, a cut-out portion of the end-box tie plate; a turbine meter located above one of the tie-plate holes; a differential pressure measurement across the tie plate; and a collapsed liquid level measurement above the tie plate. A single-module air and water apparatus simulates the reactor during reflood. Tests are done with the upper plenum empty, and with it containing simulated control rod guide tubes and baffle plates. The flow regimes studied are flooded and unflooded countercurrent flow, upflow, and combined injection. The upper plenum internals have a significant effect on the behavior of the two-phase flow. An algorithm to determine the individual mass flow rates of gas and liquid is presented. This algorithm depends on the drag body force measurement, the differential pressure measurement, the collapsed liquid level, and the flooding line.

36852 (NUREG/CP—0082-Vol.4, pp 265-276) **Dryout front modeling for rod bundles.** Griffith, P.; Mohamed, J.A.; Brown, D. (Massachusetts Institute of Technology, Cambridge). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The dryout zone is that region between the calculated pool liquid level and the point where a rod or tube submerged in the pool dries out. A method of calculating the extent of the dryout zone is presented. Recommended values for the drift flux model constants are given for rod bundles. These are needed to make these calculations. For void fractions less than 0.45 at the free surface, the dryout front and the water are level virtually the same. For void fractions above, 0.45, the extent of the dryout front is proportioned to the superficial velocity of the vapor, rising to a value of .3m for a superficial velocity of 2m/s.

36853 (NUREG/CP—0082-Vol.4, pp 277-300) **Steam separator modeling for various nuclear reactor accidents.** Paik, C.Y.; Mullen, G.; Knoess, C.; Griffith, P. (Massachusetts Institute of Technology, Cambridge). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This is a progress report on the MIT program on separator modeling. Experiments were performed using air and water on three types of centrifugal separators plus gravity and secondary separators. Experiments were also done in the MIT blowdown rig, with and without centrifugal separator, using steam and water. Appreciable carry-over from the steam generator occurs when the drain lines from the three stages of separation (centrifugal, gravity, and secondary) are unable to carry-off the liquid flow due to the high downcomer water level. Failure scenarios of the separator for extreme range of conditions from the quasi-steady-state transients to the fast transients are presented. A module showing the general separator model structure is provided and recommendations are made how to model the separator.

36854 (NUREG/CP—0082-Vol.4, pp 301-316) **Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend.** Lin, W.K.; Hsu, Y.Y. (Univ. of Maryland, College Park). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

To understand the thermal-hydraulic behavior of a B & W reactor, it is important to have knowledge about the inventory distribution in the hot leg. For inventory calculation, and for phase separation, one needs to know the phase distribution in hot leg as the flow approaching the U-bend. The present study centers on the description of void and velocity profile in the hot-leg near the U-

bend. The profiles were measured experimentally and an expression for the profile distributions was also derived analytically to represent the experimental data. The data were taken from air-water two-phase flow in a transparent U-bend channel of 3.5 in diameter. In this report, the following results will be presented: (1) analytical form of velocity profile in a curved channel; (2) experimentally measured void and velocity profiles based upon simultaneous measurements through a combined pito-tube conductance probe; (3) comparison of cross-sectionally integrated void and velocity values with global measurements; (4) a modified drift-flux model for curved channel; and (5) a weir-model to relate flow rate over the U-bend and the liquid level height at the U-bend.

36855 (NUREG/CP—0082-Vol.4, pp 317-340) **Simulation experiments for hot-leg u-bend two-phase flow phenomena.** Ishii, M.; Hsu, J.T.; Tucholke, D.; Lambert, G.; Kataoka, I. (Argonne National Lab., IL). Feb 1987. (CONF-8610135—Vol.4). Contract W-31-109-ENG-38.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In order to study the two-phase natural circulation and flow termination during a small break loss of coolant accident in LWR, simulation experiments have been performed. Based on the two-phase flow scaling criteria developed under this program, an adiabatic hot leg U-bend simulation loop using nitrogen gas and water and a Freon 113 boiling and condensation loop were built. The nitrogen-water system has been used to isolate key hydrodynamic phenomena from heat transfer problems, whereas the Freon loop has been used to study the effect of phase changes and fluid properties. Various tests were carried out to establish the basic mechanism of the flow termination and reestablishment as well as to obtain essential information on scale effects of parameters such as the loop frictional resistance, thermal center, U-bend curvature and inlet geometry. In addition to the above experimental study, a preliminary modeling study has been carried out for two-phase flow in a large vertical pipe at relatively low gas fluxes typical of natural circulation conditions.

36856 (NUREG/CP—0082-Vol.4, pp 341-362) **Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs.** Tuomisto, H. (Imatron Voima Oy, Helsinki, Finland). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper describes the test facility and test program for studying thermal mixing of high-pressure injection (HPI) water in the two-fifths scale model of three cold legs, semiannular downcomer and lower plenum of a pressurized water reactor. The test facility was originally designed to model the Finnish Loviisa plant but it was redesigned and modified for this test program. The facility can be operated at atmospheric pressure with loop and HPI flows from different cold legs in the area of interest to pressurized thermal shock. The full buoyancy effect was induced by salt addition and the HPI temperature was used as a tracer. The test matrix consists of 20 tests. The varied parameters were flow rates and the number and configuration of cold legs with HPI and loop flows. Four tests were done with decreasing loop flow temperature to simulate primary flows during steam line breaks.

36857 (NUREG/CP—0082-Vol.4, pp 363-386) **Scaling of thermal mixing phenomena from one-fifth to full scale test facilities.** Theofanous, T.G.; Iyer, K.; Shabana, E. (Univ. of California, Santa Barbara). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Thermal mixing in relation to pressurized thermal shock has been examined experimentally at various scales. In order of size these facilities include: CREARE (1/5), IVO (2/5), PURDUE (1/2) (presently at UCSB), CREARE (1/2), HDR and UPTF. The HDR experiments were run at prototypic pressure and temperature conditions; however, the cold leg diameter and downcomer gap in this reactor is only about one-half of those in full-scale commercial PWRs. The UPTF, on the other hand, is a full-scale replica of a PWR. Because of its pressure rating, however, it can operate only up to 200°C. The purpose of this paper is: (a) to show the first predictions using the regional mixing model (RMM) of the recently released UPTF data and (b) to demonstrate the use of RMM as a scaling tool over the whole range of scales.

36858 (NUREG/CP—0082-Vol.4, pp 387-406) **Summary of CCTF test results.** Iguchi, T.; Murao, Y.; Sugimoto, J.; Akimoto, H.; Okubo, T.; Hojo, T. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Conservatism of current safety analysis was assessed by comparing the predicted result with cylindrical core test facility (CCTF) test result performed at Japan Atomic Energy Research Institute. WREM code was selected for the assessment. The overall conservatism of the WREM code on the peak clad temperature prediction was confirmed against CCTF evaluation model (EM) test which simulated the typical initial and boundary conditions in the safety evaluation analysis. WREM code predicted the reasonable core boundary conditions and the conservatism of the code came mainly from core calculation. The conservatism of the WREM code against CCTF data could be attributed to the following three points: (1) no horizontal mixing assumption between subchannels at each elevation; (2) no modeling on heat transfer enhancement caused by the radial core power profile; and (3) conservative heat transfer correlations in the code.

36859 (NUREG/CP—0082-Vol.4, pp 407-428) **SCTF-III test plan and recent SCTF-III test result.** Iguchi, T.; Iwamura, T.; Akimoto, J.; Onuki, A.; Abe, Y.; Hojo, T.; Sakaki, I.; Minato, A.; Adachi, H.; Murao, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Test plan of Slab Core Test Facility with Core-III (SCTF-III) has been clarified. The previous SCTF-III tests simulating PWRs with combined-injection-type ECCS indicated the following results on the thermal-hydraulics in full-radius core. (1) two-region separation and multidimensional thermal-hydraulics both before and after reflood initiation; (2) practically no core cooling in the region far from water downflow region before reflood initiation in spite of good core cooling in water downflow region; (3) good core cooling even in two-phase upflow region after bottom reflood initiation; (4) large fall-back flow rate in comparison with the prediction by typical one-dimensional correlation.

36860 (NUREG/CP—0082-Vol.4, pp 429-444) **Heat transfer enhancement in SCTF tests.** Iwamura, T.; Adachi, H.; Sobajima, M.; Ohnuki, A.; Okubo, T.; Abe, Y.; Murao, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The reflood tests using the Slab Core Test Facility (SCTF) of Japan Atomic Energy Research Institute indicated that the radial power distribution induced the heat transfer enhancement above the quench front for higher power bundles. The two-dimensional distribution of heat transfer coefficient was closely related to the two-dimensional distribution of normalized local pressure drop. The Bromley type film boiling heat transfer correlation was not able to predict the two-dimensional heat transfer behavior. Based on a dispersed flow model, the heat transfer coefficient was expressed as the sum of three terms; radiation, droplet impingement, and forced convection of steam. The heat transfer coefficients calculated with this model agreed well with the data from the SCTF, the Cylindrical Core Test Facility and the FLECHT-SEASET when the liquid fraction was less than 0.1. The heat transfer enhancement for higher power bundles due to the radial power distribution was predicted well with this model.

36861 (NUREG/CP—0082-Vol.4, pp 445-458) **Development of reflood model at JAERI.** Murao, Y.; Iguchi, T.; Adachi, H.; Akimoto, H.; Okubo, T.; Hojo, T.; Iwamura, T.; Ohnuki, A.; Abe, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In the safety analysis on the Loss-of-Coolant Accident (LOCA) of pressurized light water reactors (PWRs), it is very important to evaluate the temperature history of the fuel rod claddings during the reflood phase, which is governing the integrity of the first enclosure of the fission product. As tools for realistic evaluation of the fuel claddings, the authors are developing best estimate models for core cooling during reflood phase based on the physical understanding of the phenomena. In order to investigate the reflooding phenomena, data from Small scale reflood test facility, Cylindrical Core Test Facility (CCTF), Slab Core Test Facility (SCTF) and Upper Plenum Test Facility (UPTF) in FRG has been used.

36862 (NUREG/CP—0082-Vol.4, pp 459-486) **UPTF test results--first three separate effects tests.** Weiss, P.A.; Hertlein, R.J. (Kraftwerk Union AG, Erlangen, West Germany). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The first separate effect tests were run in the Upper Plenum Test Facility - a 1:1 representation of a PWR primary system. These tests were focusing the simultaneous steam up - and water down flow phenomena at the upper tie plate, the fluid-fluid mixing in the cold leg and downcomer and the counter-current flow conditions of steam and saturated water in a PWR hot leg.

36863 (NUREG/CP—0082-Vol.4, pp 487-498) **Analysis results from the Los Alamos 2D/3D program.** Boyack, B.E.; Cappiello, M.W.; Stumpf, H.; Shire, P.; Gilbert, J.; Hedstrom, J. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Los Alamos National Laboratory is a participant in the 2D/3D program. Activities conducted at Los Alamos National Laboratory in support of 2D/3D program goals include analysis support of facility design, construction, and operation; provision of boundary and initial conditions for test facility operations based on analysis of pressurized water reactors; performance of pretest and post-test predictions and analyses; and use of experimental results to validate and assess the single- and multidimensional nonequilibrium features in the Transient Reactor Analysis Code (TRAC). During Fiscal Year 1986, Los Alamos conducted analytical assessment activities using data from the Cylindrical Core Test Facility and the Slab Core Test Facility. Los Alamos also continued to provide support analysis for the planning of Upper Plenum Test Facility experiments. Finally, Los Alamos either completed or is currently working on three areas of TRAC modeling improvement. In this paper, Los Alamos activities during Fiscal Year 1986 are summarized; several significant accomplishments are described in more detail to illustrate the work activities at Los Alamos.

36864 (NUREG/CP—0082-Vol.4, pp 499-521) **Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation.** Riegel, B.; Plank, H.; Liesch, K. (Gesellschaft fuer Reaktorsicherheit, Garching, West Germany). Feb 1987. (CONF-8610135—Vol.4).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The 3D-Vessel capability of TRAC-PF1/Mod1 (12.5) was used to study the influence of combined cold and hot leg ECC injection on flow and temperature distributions in the upper plenum as well as on the water break through from the upper plenum to the core region and finally on the core cooling. Two LOCA calculations have been performed. Based on a German Pressurized Water Reactor (GPWR) system a TRAC-PF1 input deck was designed to simulate the pressure vessel by a three-dimensional component of 15 axial levels, 4 radial rings and 8 azimuthal segments, the 4 loops separately by one-dimensional components including a fine noding of the steam generators and the main coolant pumps, and the complete ECC-injection system (cold and hot leg injection) consisting of high and low pressure pumps and accumulators.

36865 (NUREG/CP—0082-Vol.5, pp 1-14) **Status of the TRAC-BWR Program.** Weaver, W.L. III; Johnson, G.W. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Transient Reactor Analysis Code for Boiling Water Reactors (TRAC-BWR) is being developed at the Idaho National Engineering Laboratory for the Division of Accident Evaluation, Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission (USNRC). Several versions of TRAC-BWR have been released, the latest one being TRAC-BF1 which was released in June, 1986. The major new features of this code include a Courant-limit-violating numerical solution procedure in the one-dimensional components and a one-dimensional neutron kinetics model. Numerous other improvements also have been made to improve code accuracy and to decrease code running time. Before this code version was released, a series of developmental assessment test cases were executed. These developmental assessment test cases included seven separate effects test cases and five integral system test cases. The results of these test cases were included in the TRAC-BF1 code manual which was published in August, 1986. This paper discusses the code improvements in TRAC-BF1 and present results of several of the developmental assessment test cases. The code development plans for FY-1987 are also presented.

36866 (NUREG/CP—0082-Vol.5, pp 15-20) **RELAP5/MOD2 development.** Miller, C.S. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.5). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Status of the RELAP5/MOD2 computer code is discussed. While the code is undergoing international assessment, emphasis is on user support and code maintenance with modifications allowed only for error correction and user convenience improvements. User support discussed is the response to user inquiries, maintenance of manuals and the implementation of a PC based newsletter service. The major 1986 user convenience improvement is the self-initialization option. The method is discussed and examples for PWR U tube and once through plants are illustrated. Future plans are also outlined.

36867 (NUREG/CP—0082-Vol.5, pp 21-40) **TRAC code development status and plans.** Spore, J.W.; Liles, D.R.; Nelson, R.A.; Dotson, P.; Steinke, R.G.; Knight, T.D.; Henninger, R.J.; Martinez, V.; Jenks, R.P.; Cappiello, M.W.; Giguere, P.T. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This report summarizes the characteristics and current status of the TRAC-PF1/MOD1 computer code. Recent error corrections and user-convenience features are described, and several user enhancements are identified. Current plans for the release of the TRAC-PF1/MOD2 computer code and some preliminary MOD2 results are presented. This new version of the TRAC code implements stability-enhancing two-step numerics into the 3-D vessel, using partial vectorization to obtain a code that has run 400% faster than the MOD1 code.

36868 (NUREG/CP—0082-Vol.5, pp 41-44) **Nuclear plant analyzer development at the Idaho National Engineering Laboratory.** Laats, E.T. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.5). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Nuclear Plant Analyzer (NPA) is a state-of-the-art safety analysis and engineering tool being used to address key nuclear power plant safety issues. Under the sponsorship of the US Nuclear Regulatory Commission (NRC), the NPA has been developed to integrate the NRC's computerized reactor behavior simulation codes such as RELAP5, TRAC-BWR and TRAC-PWR, with well-developed computer color graphics programs and large repositories of reactor design and experimental data. An important fea-

ture of the NPA is the capability to allow an analyst to redirect a RELAP5 or TRAC calculation as it progresses through its simulated scenario. The analyst can have the same power plant control capabilities as the operator of an actual plant. The NPA resides on the dual Control Data Corporation Cyber 176 mainframe computers at the Idaho National Engineering Laboratory and Cray-1S computers at the Los Alamos National Laboratory (LANL) and Kirtland Air Force Weapons Laboratory (KAFWL). During the past year, the NPA program at the INEL has addressed two primary areas: software development and user support. These activities are discussed in the paper.

36869 (NUREG/CP—0082-Vol.5, pp 45-56) **BWR plant analyzer development at BNL.** Wulff, W.; Cheng, H.S.; Mallen, A.N. (Brookhaven National Lab., Upton, NY). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An engineering plant analyzer has been developed at BNL for realistically and accurately simulating transients and severe abnormal events in BWR power plants. Simulations are being carried out routinely with high fidelity, high simulation speed, at low cost and with unsurpassed user convenience. The BNL Plant Analyzer is the only operating facility which (a) simulates more than two orders-of-magnitude faster than the CDC-7600 mainframe computer, (b) is accessible and fully operational in on-line interactive mode, remotely from anywhere in the US, from Europe or the Far East (Korea), via widely available IBM-PC compatible personal computers, standard modems and telephone lines, (c) simulates both slow and rapid transients seven times faster than real-time speed in direct access, and four times faster in remote access modes, (d) achieves high simulation speed without compromising fidelity, and (e) is available to remote access users at the low cost of $160 per hour. The accomplishment of detailed and accurate simulations in complex power plants at high speed and low cost are due chiefly to two reasons. The first reason is the application of five distinct modeling principles [2] which are not employed in any other simulation code. The second, and even more important reason is the utilization of a special-purpose peripheral computer with its 13 task-specific parallel processors.

36870 (NUREG/CP—0082-Vol.5, pp 57-66) **Nuclear plant data bank.** Booker, C.P.; Turner, M.R.; Spore, J.W. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Nuclear Plant Data Bank (NPDB) is being developed at the Los Alamos National Laboratory to assist analysts in the rapid and accurate creation of input decks for reactor transient analysis. The NPDB will reduce the time and cost of the creation or modification of a typical input deck. This data bank will be an invaluable tool in the timely investigation of recent and ongoing nuclear reactor safety analysis. This paper discusses the status and plans for the NPDB development and describes its anticipated structure and capabilities.

36871 (NUREG/CP—0082-Vol.5, pp 67-80) **Physical model for reactor coolant pumps.** Schneider, K.; Winkler, F.J. (Kraftwerk Union AG, Erlangen, West Germany). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

To predict two-phase flow pump performance under LOCA-conditions a new pump model was developed. Foundations of the model are analytical treatments, dimensional analysis and stationary two-phase flow experiments with pump models of different type. Phase separational effects in the impeller, slip phenomena and the high compressibility of two-phase flow are treated to be the cause of two-phase flow pump head and torque degradation. Kinematic similarity law of one-phase flow pump performance is not fulfilled in the model and therefore at high mass flow a pronounced degradation of head and torque is predicted. Consequently the mechanical load on the main coolant pump in the broken leg under LOCA conditions is smaller than calculated with previous models.

36872 (NUREG/CP—0082-Vol.5, pp 81-102) **Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG.** Winkler, F.J. (Kraftwerk Union AG, Erlangen, West Germany). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The BMFT of FRG is participating in the ICAP in which KWU and GRS as its agents have already performed six code assessment studies. This paper compares main results of the calculations with the experimental results used for the code assessment of RELAP 5/MOD 2 and TRAC-PF1/MOD 1.

36873 (NUREG/CP—0082-Vol.5, pp 103-116) **CSNI validation matrix for PWR and BWR codes.** Wolfert, K.; Brittain, I. (Gesellschaft fuer Reaktorsicherheit, Garching, West Germany). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An internationally agreed validation matrix for PWR and BWR thermal-hydraulic system codes has been established by the CSNI-PWG-2 Task Group on Status and Assessment of Codes for Transients and ECCS. The matrix will be a guide for independent code assessment, will be a basis for the comparisons of code predictions performed with different system codes, and may contribute to the quantification of the uncertainty range of code predictions.

36874 (NUREG/CP—0082-Vol.5, pp 117-132) **Swedish experience with RELAP5/MOD2 assessment.** Sandervag, O. (Studsvik Energiteknik AB, Nykoping, Sweden). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Swedish assessment of RELAP5/MOD2 is a part of the International Code Assessment program which is organized by the US NRC. The major part of the experimental data used for assessment is of Swedish origin. The data encompass critical flow and level swell data from the Marviken facility. A part of the agreed assessment matrix has been completed. Comparison with BWR integral test data shows that the major phenomena which control the core cooling during intermediate and large break LOCA are qualitatively reproduced by RELAP5. Assessment against separate and integral experiments shows that the dominant uncertainty in prediction of clad temperatures is due to a poor calculation of dryout. Predicted post dryout wall temperatures, given the experimental dryout location as input parameter, generally agree well with data. Simulations of level swell following depressurization of the large diameter Marviken vessel showed that RELAP5/MOD2 was able to calculate overall axial void profiles in fair agreement with data. The assessment indicated that increasing the modeling detail could give rise to numerical instabilities. Assessment against large scale critical flow data revealed that the agreement with data was somewhat dependent on upstream fluid conditions and modeling. Low quality two phase flow was, in general, accurately predicted while subcooled liquid flow and saturated steam flow were generally overpredicted if no discharge coefficient was applied.

36875 (NUREG/CP—0082-Vol.5, pp 133-142) **Finnish assessment of RELAP5/MOD2.** Holmstroem, H. (Technical Research Center of Finland). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The first frozen version of RELAP5/MOD2 (cycle 36) was received in Finland in February 1985. Four assessment cases and several hypothetical LPWR cases have been calculated so far. The code has generally produced better results and run better than MOD1. However, some problems have been encountered. There still seems to be discontinuities in the code and the interphase friction seems to be excessive.

36876 (NUREG/CP—0082-Vol.5, pp 143-154) **TRAC development at General Electric.** Andersen, J.G.M.; Shaug, J.C.; Shiralkar, B.S. (General Electric Co., San Jose, CA). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

TRAC is a computer code for transient analysis of light water reactors. The BWR version of TRAC has been developed as a result of a close cooperation between General Electric Company and Idaho National Engineering Laboratory. Up through 1985 the development work at General Electric was jointly funded by General Electric, the Nuclear Regulatory Commission and Electric Power Research Institute under the Refill-Reflood and FIST programs. At INEL (which has the main responsibility for the NRC version of TRAC-BWR) this work has led to the development of TRACBD1 and TRACBF1, while at GE, TRACB04 was the final product of the Refill-Reflood and FIST programs. TRAC development has continued at General Electric after the completion of these programs with the evolution of the TRACG code. The purpose of the paper is to describe this work. The TRAC development at General Electric can be divided into two main categories: extended benchmark capability and improved user convenience.

36877 (NUREG/CP—0082-Vol.5, pp 155-178) **Three-D neutronics model implementation into TRAC-BD1.** Tsunoyama, S.; Uematsu, H.; Shaug, J.C.; Namba, H.; Shiralkar, B.S. (Nippon Atomic Industry Co., Kanagawa, Japan). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A three-dimensional neutron kinetics model has been developed and implemented into the detailed thermal-hydraulic model of the boiling water reactor (BWR) version of TRAC (TRAC-BWR). The resulting code has been given the name TRAC/TOSDYN. The version of TRAC-BD1 employed here is Version 12, which was developed by the Idaho National Engineering Laboratory. The development of TRAC was directed towards performing advanced, best-estimate analyses of the thermal-hydraulic response of hypothesized accidents. Incorporating a three-dimensional neutronics model into TRAC, its capability is increased, and it becomes widely applicable from the hypothetical loss of coolant accident, to plant transients with neutronic space-dependent perturbations. The neutronics model was derived from a best-estimate BWR core model, called TOSDYN. TOSDYN consists of three dimensional neutron kinetics and a parallel channel thermal-hydraulic model. The purpose of this paper is to provide (1) a brief description of the TOSDYN neutronics model and solution method, and (2) simulation of a sample transient with statistics of computer running time for TRAC/TOSDYN.

36878 (NUREG/CP—0082-Vol.5, pp 179-196) **Validation of TRAC-PD2 against experiment LP-02-6 of the OECD-LOFT series.** Alonso, A.; Blanco, J.; Martinez, J.C.; Querol, A.; Rivero, J.; Mora, J.L. (Madrid Polytechnical Univ., Spain). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Experiment LP-02-6 of the LOFT-OECD series has been analyzed with TRAC-PD2. Pretest, steady state and post-test calculations have been performed. Pump behavior was improved by modifying the inertia equation and the two-phase torque and head multipliers. Some improvement were also introduced regarding to pressure losses. Accumulator characterization and chocked flow were also studied. Some errors in the code were also corrected. Rod temperature profile and time to early rewet were improved by modifying correlations in the code, mainly minimum film boiling temperature. After testing several correlations, it was determined that Sakurai's gives acceptable results for pressures above 5,5 bars. For pressures below 5 bars the homogeneous nucleation correlation is superior and for intermediate values an interpolation between the two. An improvement in the time to rewet is also obtained, but it is not yet satisfactory. The research effort is now concentrated in improving this aspect.

36879 (NUREG/CP—0082-Vol.5, pp 197-208) **Code uncertainty quantification.** Odar, F.; Hanson, R.G. (Nuclear Regulatory Commission, Rockville, MD). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper presents an overview of a methodology developed to quantify reactor safety computer code uncertainty. The methodology development program is supported by the Idaho National Engineering Laboratory, and Los Alamos National Laboratory and is sponsored by the US Nuclear Regulatory Commission. The method addresses code minus experimental data differences from scaled facilities and provides a systematic extension of the scaled uncertainty statements to a full scale code application. Conclusions are made relative to the application of the method, interpretation of the results, and method limitations.

36880 (NUREG/CP—0082-Vol.5, pp 209-230) **Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment.** Kmetyk, L.N.; Elrick, M.G.; Byers, R.K.; Buxton, L.D. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.5). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Code assessment is performed to obtain a judgement of the accuracy and validity of any given code over its range of applicability. To achieve this, the codes are exercised against a matrix of experiments, resulting in comparisons between code predictions and measured data. Thus far, conclusions on code accuracy drawn from previous independent assessment studies have appeared to be mostly phenomenological and/or qualitative. There is an increasing emphasis within the NRC code assessment effort to formulate more coherent, quantitative conclusions on the capabilities and accuracies of the codes. This can be done by using statistically-based methods to evaluate the overall accuracy of the codes with respect to particular key phenomena, based on the same code analyses of individual experiments. One possibility for a code accuracy quantification methodology is presented in this paper.

36881 (NUREG/CP—0082-Vol.5, pp 231-260) **Tests of the TRAC code against known analytical solutions for stratified flow.** Black, P.S.; Leslie, D.C.; Hewitt, G.F. (Queen Mary College, London, England). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The area averaged equations for gas-liquid flow are briefly summarized and related, for the specific case of stratified flow, to the shallow water equations commonly used in hydraulics. These equations are then compared to the equations used in TRAC-PF/MOD1 and are shown to differ in their treatment of the gravity head terms. A modification of the TRAC code is therefore necessary to bring it into line with established shallow water theory. The corrected form of the code was compared with a number of specific cases, each of which throws further light on the code behavior. The following areas are discussed in the paper: (1) the dam break problem; (2) Kelvin-Helmholtz instability; (3) counter-current flow; and (4) slug flow. It is concluded that detailed comparisons of the code with known analytic solutions and with a number of the more complex phenomenological experiments can give useful insights into its behavior.

36882 (NUREG/CP—0082-Vol.5, pp 261-280) **Cold leg condensation in a large break LOCA using TRAC-PF1/MOD1.** Dawson, J.T. (Berkeley Nuclear Labs., England). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Results from integral and separate effects tests indicate that the liquid-vapor condensation models used in TRAC-PF1/MOD1 are over-simplified. In particular they neglect the enhancement of local turbulence from impinging jets and wall films, exclude interface shattering, and employ a physically unrealistic liquid plug detection algorithm. This paper describes two sensitivity studies on a postulated PWR large break loss-of-coolant accident to investigate the effects of modifying condensation modelling in the intact cold legs. The results indicate that changes of an order of magnitude in condensation heat transfer coefficients and areas would have only a small effect on the course of a transient. The changes would probably be most significant if interface shattering occurred, but even this would be unlikely to change the start of reflood by more than a few seconds.

36883 (NUREG/CP—0082-Vol.5, pp 281-304) **Some preliminary results of post-dryout heat transfer measurements at low qualities and pressures up to 20 bar.** Swinnerton, D.; Pearson, K.G.; O'Mahoney, R. (United Kingdom Atomic Energy Authority, Winfrith). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Steady state data have been obtained on post-dryout heat transfer for flow in a tube of inside diameter 10 mm and length 920 mm. The experiments covered mass velocities up to 200 kg/m²s at 10 and 20 bar and up to 1000 kg/m²s at 2 and 5 bar. Inlet qualities were close to zero and the equilibrium quality at exit ranged up to 60%. The tube was prevented from rewetting by massive copper hot patches, brazed to it at each end. Surface temperature measurements were made along the length of the tube. An in-stream thermocouple inserted into the flow at exit from the tube provided a measure of vapor temperature at this location. Typical sets of data are presented and the trends discussed. These new data extend the range of the available database against which the combined effects of the heat transfer and hydraulic models in reactor safety codes can be assessed. Comparisons are made with predictions obtained using the TRAC-PF1/MOD1 computer code and the reflood code BERTHA.

36884 (NUREG/CP—0082-Vol.5, pp 305-328) **JRC ISPRA experience with the IBM version of RELAP5/MOD2.** Kolar, W.; Staedtke, H.; Worth, B. (Commission of the European Communities, Ispra, Italy). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Various RELAP5 code versions have been used extensively within the LOBI Project at the Joint Research Center (JRC) in Ispra for test design calculations, pre-test predictions and post-test analysis. The results obtained represent an important contribution to the multi-national effort for the RELAP5 code assessment. The paper focuses mainly on the latest version RELAP5/MOD2 cycle 36.04. Problems related to the conversion of the code from CDC to an IBM compatible form are outlined in the paper. The prediction capability of the code is demonstrated by comparison of predicted and measured data for different LOBI integral system experiments.

36885 (NUREG/CP—0082-Vol.5, pp 329-370) **Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions.** Analytis, G.Th.; Richner, M.; Andreani, M.; Aksan, S.N. (Swiss Federal Institute for Reactor Research, Wuerenlingen, Switzerland). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Assessment calculations for the thermal hydraulic transient computer codes RELAP5/MOD2 (frozen version 36.02) and TRAC-BD1/MOD1 (frozen version 22) were performed, at Swiss Federal Institute for Reactor Research (EIR), under both core uncovery (boil-off) and reflooding conditions. The aim of the work being to assess the predicting capabilities of the frozen versions of the best estimate computer codes. Some of the reflooding and boil-off experimental data obtained from NEPTUN test facility at EIR are used for the assessment work. Model optimization calculations on nodalization and effect of available options (e.g. heat slab sizes) are performed with a selected base case and the same model is applied to the rest of the other experimental cases covering wide range of parameters. In this paper, the authors report the results of these assessment calculations and identify and point out the existing uncertainty areas in boil-off and reflooding phenomena. On the basis of the further calculations by changing some of the models such as bubbly/slug flow interfacial friction and film boiling heat transfer correlations in the frozen versions of the codes, improvements which eliminate some of the problems will be recommended.

36886 (NUREG/CP—0082-Vol.5, pp 371-380) **Status of the Mexican nuclear power program.** Miguel, M.V.; Enrique, S.B. (Comision Nacional de Seguridad Nuclear y Salvaguardias, Mexico). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Laguna Verde Nuclear Power Project, currently the only nuclear power project of the country is described. It consists of two 654 MWe boiling water reactor units. The first unit is expected to load fuel during the second quarter of 1987; and the second unit is 45% advanced in its construction and little work is done in this unit because of lack of funds. The long construction period of the project has permitted the country to prepare personnel and infrastructure for design, construction and operation of a NPP, in the regulatory field, research and development and industrial fields also, so that future projects could have a larger national participation and there are good capabilities to support the orderly and safe operation of the Laguna Verde NPP. On the other hand, the country depends on oil for 93% of its energy needs. The national energy program calls for the diversification of the energy sources. The main conclusion is that Mexico needs to start as soon as possible a second Nuclear Power Project within the framework of the Nuclear Power Program that calls for at least 5000 MWe to be installed for the year 2000.

36887 (NUREG/CP—0082-Vol.5, pp 381-394) **Status of J-TRAC code development.** Akimoto, H.; Iwamura, T.; Ohnuki, A.; Abe, Y.; Murao, Y. (Japan Atomic Energy Research Institute, Ibaraki). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

J-TRAC program is a code developmental program which started in 1984 at Japan Atomic Energy Research Institute to develop a standard code for reactor safety assessment. J-TRAC will be developed by using TRAC-PF1/MOD1 code as the framework of the code and by improving the physical models for the refill and reflood phases of a PWR LOCA based on the physical understanding of phenomena. In the paper, the followings will be described as the current status of J-TRAC program; (1) assessment of TRAC-PF1/MOD1 code for typical large break LOCA experiments focussed on the reflood test; (2) improvement of reflood model. The problem areas will be identified where the future improvement of the physical models are required in TRAC-PF1/MOD1 code and it will be shown that the predictive capability and the calculation efficiency of TRAC-PF1/MOD1 are highly improved by the modification of the interfacial friction model and the film boiling heat transfer model for the reflood analyses.

36888 (NUREG/CP—0082-Vol.5, pp 395-444) **Application of engineering and multi-dimensional, finite difference codes to HDR thermal mixing experiments.** Wolf, L.; Schygulla, U.; Haefner, W.; Fischer, K.; Baumann, W.; Theofanous, T.G. (PHDR/KfK, Karlsruhe, West Germany). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

During Phase II of the HDR Safety Program, a total of 26 thermal mixing experiments have been performed at the HDR-facility. These large-scale experiments were performed with three different HPI-nozzle arrangements over a broad spectrum of Froude-numbers for both finite loop flow and stagnant loop conditions. Only one cold leg was simulated at the HDR, thereby resulting in an asymmetric cooldown behavior of the downcomer. In a truly multi-national analytical effort (USA-FRG) the following codes: COMMIX-1B (INR/KfK); SOLA-PTS (BF); JETMIX (BF); REMIX (Purdue Univ., USCB, USA); VOLMIX (BF) were applied to the HDR-experiments under strictly blind pre-test conditions. Advantages and disadvantages of the various codes and models will be identified on the basis of the consistent comparisons. Overall, it will be demonstrated that the applications of both multi-dimensional and engineering type methodologies provide the potential user with the opportunity to choose from a variety of tools dependent upon his resources and needs for insights into physical phenomena.

36889 (NUREG/CP—0082-Vol.5, pp 445-522) **Nuclear safety—forward on technology and backward on perception.** Loewenstein, W.B.; Thomas, G.R. (Electric Power Research Institute, Palo Alto, CA). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The US exceeded 1000 reactor-years of commercial operation and has 101 licensed reactors which should supply ~ 16% of all US electric power. There were major technical advances in nuclear safety with improvements in: plant control, efficiency and safety; understanding seismic consequences; the ability to analyze plant behavior for normal conditions through hypothetical severe accidents; and in supporting experimental data. However, this year also saw the unfortunate Chernobyl accident. EPRI's nuclear safety research program greatly matured this past year. Initial versions of several advanced computer-aided tools were produced for improving both plant output and safety. Understanding seismic ground responses improved. A generic program of research on large-scale hydrogen-air mixing and combustion has been completed. A major owner's group experimental effort is nearing completion characterizing such behavior in BWR6 Mark III containments. With the US, EPRI is involved in many national and international collaborative efforts such as the TREAT STEP and the MIST B & W tests, the OECD LOFT program and both the LACE and Marviken aerosol-behavior experimental programs. This paper reviews EPRI's nuclear safety research program in the context of this new transitional phase and how it is meeting the everyday challenges of commercial nuclear power.

36890 (NUREG/CP—0082-Vol.5, pp 523-530) **Containment and piping research.** Tang, H.T.; Tagart, S.W. (Electric Power Research Institute, Palo Alto, CA). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Containment and piping integrity research at EPRI is briefly described in the paper. The containment integrity research focuses on the determination of failure modes and load-carrying capabilities of concrete reactor containments under internal pressures beyond design basis. The objective of this research is to provide a more realistic basis for overall reactor risk studies. Results to date show potential of liner crack in discontinuity regions and stable crack propagation (with arrest) due to liner-concrete interaction. This finding supports the hypothesis that concrete containment will leak before break under severe core type of loading. The piping integrity research focuses on demonstrating and quantifying the true failure mechanism of dynamically loaded piping. Tests performed to date show that piping will fail in a fatigue rachetting manner rather than static plastic-collapse which is the basis of current ASME code equations. Additionally, test results suggest that at least an order of magnitude excess margin exists in the current standards. Based on these findings, improved rules for piping design and evaluation will be developed and proposed.

36891 (NUREG/CP—0082-Vol.5, pp 531-552) **Use of probabilistic systems analysis for enhancing plant operational safety and productivity.** Chu, B.B.; Worledge, D.H.; Whitesel, R.N.; Stevens, C.R. (Electrical Power Research Institute, Palo Alto, CA). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The subject study is a major on-going R & D endeavor at Electric Power Research Institute. The study is developing a practical tool which combines key features of plant information management systems with applications of system reliability analysis techniques to assist plant personnel and engineering staff in performing their functions more effectively and accurately. It has two major tasks: (1) to develop a user-friendly, integrated computer software; and (2) to demonstrate the applications and value of this software on-site. The software named Reliability Assessment Program with Integral Data, or RAPID, is an aggregate of many stand-alone computer codes. It consists of three interrelated elements: (1) an Executive Controller which provides the users with interface to and control of the other two elements; (2) a Data Base Manager which administers the data file management; and (3) Applications Modules which perform specific engineering functions. RAPID has essentially been developed and is being demonstrated at two utilities companies.

36892 (NUREG/CP—0082-Vol.5, pp 553-574) **Seismic hazard methodology for nuclear facilities: modeling input interpretations.** Stepp, J.C.; McGuire, R.K. (Electric Power Research Institute, Palo Alto, CA). Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Recently developments of probabilistic seismic hazard methodology specifically to assess hazard at low probabilities of ($< 10^{-3}$ per year) at locations in the central and eastern US have been based on input interpretations by multiple experts. In these studies, a number of individual scientists or teams of scientists provide interpretations of seismic sources and their associated seismicity parameters. To express uncertainty, multiple alternative interpretations are provided. Uncertainty about seismic wave attenuation is treated similarly by assigning weights to potentially applicable attenuation relationships. A seismic hazard methodology developed at the Electric Power Research Institute (EPRI) follows this general approach. However, a number of modifications have been incorporated to provide fully trackable interpretations of input parameters based on state-of-the-art earth science practice, to specifically distinguish scientific and information uncertainty, and to make maximum use of historic earthquake data to assess seismicity parameters. The goal of the program has been to develop a procedure that is consistent with earth science practice, that facilitates expressions of uncertainty in seismic hazard input interpretations, and that is generally applicable.

36893 (NUREG/CP—0082-Vol.5, pp 575-580) **Role of oversight within NRR and its effect on industry.** Bosnak, R.J. Feb 1987. (CONF-8610135—Vol.5).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Industry performing research, developing new technology, developing new analytical methods and procedures not previously used, intended to be applied to operating nuclear power plants or plants still under construction, should be aware of the fact that the last reorganization of the Office of Nuclear Reactor Regulation established a Division of Safety Review and Oversight (DSRO) and three separate licensing divisions, each with its own separate technical review staff. The need for Oversight was anticipated as being necessary to achieve consistency in the licensing reviews of the three divisions which are categorized by NSSS manufacturer type. Industry should be aware of and plan for necessary presentations and discussions with the NRR staff on the results of their work and how it is intended to be applied to plant specific licensing situations. DSRO, in its Oversight function, stands ready to assist the industry in the acceptance of new analytical methods and procedures, but unless such considerations are planned for and factored into specific plant schedules, there is a risk that such methods and procedures may not be accepted for plant specific application in the time frame desired.

36894 (NUREG/CP—0082-Vol.6, pp 1-18) **TMI-2 lower vessel debris examinations.** Akers, D.W.; Olsen, C.S.; Strain, R.V. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.6). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Samples of prior molten debris have been retrieved from the lower reactor head of the TMI-2 reactor. Preliminary results of the examination of these samples are presented with particular emphasis on the metallurgical and radiochemical characteristics of the materials. Areas of nearly pure fuel material in a stoichiometric, $(U,Zr)O_2$ matrix occurred which indicate temperatures approaching the melting point of $UO_2$ (up to 3100 K). Comparison of the measured radionuclide concentrations in the debris with ORIGEN-2 calculated concentrations indicates significant retention of Cs-137 (up to 22%) in the prior molten debris. Autoradiography results suggest significant accumulations of activity on the surfaces of voids in the debris and at grain boundaries.

36895 (NUREG/CP—0082-Vol.6, pp 19-38) **Preliminary results of the TMI-2 core bores.** McCardell, R.K.; Tolman, E.L.; Martin, M.R.; Smith, R.P. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.6). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper presents the core bore acquisition data available to date from the Department of Energy TMI-2 Sample Acquisition and Examination Program. Core bore samples have been recently acquired and video inspection of the lower core and core support regions have been completed via the core bore access holes. The data summarized in the paper include basic observations characterizing the lower region of the core, the core support assembly and lower plenum debris, and details showing how an end-state core configuration was estimated. Implications of the core bore acquisition data on the core damage are discussed in a companion paper also presented in the conference.

36896 (NUREG/CP—0082-Vol.6, pp 39-54) **TMI-2 accident scenario update.** Tolman, E.L.; Kuan, P.; Broughton, J.M. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.6). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Estimates of the end-state core configuration have been developed from recent inspection of the lower regions of the TMI-2 core, core support assembly, and lower plenum regions. The inspection data have provided a basis for estimating the extent of damage to the core and core support structures and have confirmed that the migration pathway of the molten core material to the lower plenum occurred in the east quadrant of the reactor vessel. This paper integrates the core inspection data with other TMI-2 data and supporting analysis to update the best-estimate core damage progression scenario.

36897 (NUREG/CP—0082-Vol.6, pp 55-66) **Update on standard problem, data base, and uncertainties.** Golden, D.W. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Three Mile Island (TMI)-2 accident provides the only data for a full-scale, integrated water reactor facility during a severe accident. The data from this accident has been, and is being, collected, reviewed, and cataloged. The data will be placed in structured data bases. To date, three data bases have been complemented: Plant Configuration, Sequence of Events, and Initial and Boundary Conditions. The data pertinent to the TMI-2 Standard Problem have been reviewed and categorized by type and level of uncertainty. As a result of the review process, it has been determined that further refinement of the estimated boundary conditions High Pressure Injection/makeup and letdown flow will be required. A demonstration calculation for the first 174 min of the accident has been completed using the RELAP/SCDAP integrated code. This calculation is in general agreement with the data for the first 100 min of the accident and in significantly less agreement beyond 100 min. Refinement of the model's nodalization is expected to correct some of the inconsistencies.

36898 (NUREG/CP—0082-Vol.6, pp 67-74) **Influence of moisture on the behavior of aerosols.** Adams, R.E.; Longest, A.W.; Tobias, M.L. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The behavior of aerosols assumed to be characteristic of those generated during light water reactor accident sequences and released into containment has been studied in the Nuclear Safety Pilot Plant located at the Oak Ridge National Laboratory. It has been observed that in a saturated steam-air environment a change occurs in the shape of aerosol agglomerates of $U_3O_8$ aerosol, $Fe_2O_3$ aerosol, and mixed $U_3O_8$-$Fe_2O_3$ aerosol from branched-chain to spherical, and that the rate of reduction in the airborne aerosol mass concentration is increased relative to the rate observed in a dry atmosphere. The effect of a steam-air environment on the behavior of concrete aerosol is different. The shape of the agglomerated concrete aerosol is intermediate between branched-chain and spherical and the effect on the rate of reduction in airborne mass concentration appears to be slight. In a related project the shape of an agglomerated $Fe_2O_3$ aerosol was observed to change from branched-chain to spherical at, or near, 100% relative humidity.

36899 (NUREG/CP—0082-Vol.6, pp 75-86) **LWR aerosol containment experiments (LACE) program summary and preliminary observations.** Muhlestein, L.D.; Bloom, G.R.; Dickinson, D.R.; Hilliard, R.K.; McCormack, J.D. (Westinghouse Hanford Co., Richland, WA). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The objective and status of the LWR Aerosol Containment Experiments (LACE) program are presented. Each of the six large-scale aerosol behavior tests is described. A description of the LACE computer code validation effort is provided, together with a listing of computer codes used in the exercise. Observations from the tests which focused on the containment bypass accident (CB, LA1, LA3) and conclusions suggested by the data are presented.

36900 (NUREG/CP—0082-Vol.6, pp 87-102) **Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3.** Wright, A.L.; Wilson, J.H.; Arwood, P.C. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.6). Contract AC05-84OR21400.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The light-water reactor (LWR) aerosol containment experiments (LACE) are being performed in Richland, Washington, at the Hanford Engineering Development Laboratory under the leadership of an international project board and the Electric Power Research Institute. These tests have two objectives: (1) to investigate, at large scale, the inherent aerosol retention behavior in LWR containments under simulated severe accident conditions, and (2) to provide an experimental data base for validating aerosol behavior and thermal-hydraulic computer codes. Aerosol computer-code comparison activities for the LACE tests are being coordinated at the Oak Ridge National Laboratory. For each of the six experiments, pretest calculations (for code-to-code comparisons) and blind post-test calculations (for code-to-test data comparisons) are being performed. This paper presents a summary of the pretest aerosol-code results for tests LA1, LA2, and LA3.

36901 (NUREG/CP—0082-Vol.6, pp 103-118) **Integrated ex-vessel source term analysis with the CONTAIN 1.1 computer code.** Murata, K.K.; Schelling, F.J.; Valdez, G.D.; Carroll, D.E.; Washington, K.E. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Important new phenomenological models and code improvements, which will be available in Version 1.1 of the CONTAIN code, are discussed, and results of a thirteen cell demonstration calculation presented. CONTAIN has been developed for the USNRC as a best-estimate code for modeling nuclear reactor containment behavior under severe accident conditions. CONTAIN 1.1 has major new capabilities for treating core-concrete interactions and boiling water reactor (BWR) containment systems. The CORCON and VANESA codes have been merged with CONTAIN for modeling the behavior of molten core interactions with concrete, and suppression pool models have been developed for use in BWR containment calculations. Significant improvements made to existing models of radiation heat transfer, pool boiling, fission product transport, and aerosol flow are also discussed. Calculational results for a BWR station blackout accident sequence illustrate the wide range of coupled physical phenomena that CONTAIN can model.

36902 (NUREG/CP—0082-Vol.6, pp 119-142) **Results from DEMONA aerosol experiments.** Kanzleiter, T.; Wolf, L.; Schoeck, W.; Bunz, H.; Haschke, D.; Hosemann, P.; Peehs, M.; Ruhmann, H.; Fischer, M.; Weber, G. (Battelle-Institut, Frankfurt, West Germany). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In the DEMONA experiments the behavior of aerosols released into a large dry PWR containment during a core meltdown accident was investigated by means of a 640 $m^3$ model containment. After performance of eight experiments with quasi-single-compartment containment geometry and one multi-compartment experiment, the DEMONA project is being completed by evaluating and recalculating the measured results. Up to now, good agreement between experiment and model calculations was achieved only for simple test conditions. Adequate modeling of more complicated test conditions requires additional analytical efforts.

36903 (NUREG/CP—0082-Vol.6, pp 143-156) **Thermal-hydraulic studies on molten core-concrete interactions.** Greene, G.A. (Brookhaven National Lab., Upton, NY). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Recent assessments of risk due to unterminated severe accidents in light water power reactors have indicated that the consequences of molten core-concrete interactions (MCCI) dominate the considerations of containment loads and performance, as well as the release of non-volatile fission product aerosols to the containment building. The issues of containment pressurization, combustible gas generation, structural erosion, fission product release, and fission product decontamination are critical in the evaluation of risk as currently being quantified by the Severe Accident Risk Reevaluation Program (SARRP). The program at BNL has focused on investigating several important aspects of MCCIs in an effort to support the integral melt-concrete programs as well as the CORCON and VANESA computer code development and verification programs at SNL. Experimental, analytical, and computational programs are currently underway to investigate and support validation of a variety of physical processes that occur during a MCCI, including interlayer heat and mass transfer, liquid-liquid boiling processes, and aerosol formation and decontamination.

36904 (NUREG/CP—0082-Vol.6, pp 157-170) **Ice condenser testing facility and plans.** Kannberg, L.D.; Ross, B.A.; Eschbach, E.J.; Ligotke, M.W. (Pacific Northwest Lab., Richland, WA). Feb 1987. (CONF-8610135—Vol.6). Contract AC06-76RL01830.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A facility is being constructed to experimentally validate the ICEDF computer code. The code was developed to estimate the extent of fission product retention in the ice compartments of pressurized water reactor ice condenser containment systems during severe accidents. The design and construction of the facility is based on a test design that addresses the validation needs of the code for conditions typical of those expected to occur during severe pressurized water reactor accidents. Detailed facility design has followed completion of a test design (i.e., assembled test cases each involving a different set of aerosol and thermohydraulic flow conditions). The test design was developed with the aid of statistical test design software and was scrutinized for applicability with the aid of ICEDF simulations. The test facility will incorporate a small section of a prototypic ice condenser (e.g., a cross section comprising the equivalent of four 1-ft-diameter ice baskets to their full prototypic height of 48 ft). The development of the test design, the detailed facility design, and the construction progress are described in this paper.

36905 (NUREG/CP—0082-Vol.6, pp 171-178) **QUASAR uncertainty study.** Khatib-Rahbar, M.; Park, C.; Davis, R.; Nourbakhsh, H.; Lee, M.; Cazzoli, E.; Schmidt, E. (Brookhaven National Lab., Upton, NY). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Over the last decade, substantial development and progress has been made in the understanding of the nature of severe accidents and associated fission product release and transport. As part of this continuing effort, the US Nuclear Regulatory Commission (USNRC) sponsored the development of the Source Term Code Package (STCP), which models core degradation, fission product release from the damaged fuel, and the subsequent migration of the fission products from the primary system to the containment and finally to the environment. In order to better establish the validity and potential applications of source term predictions from these phenomenological models, quantification of the uncertainties associated with the STCP calculated source terms is essential. The objectives of the QUASAR (Quantification and Uncertainty Analysis of Source Terms for Severe Accidents in Light Water Reactors) program are: (1) to address the uncertainties associated with input parameters and phenomenological models used in the STCP, and (2) to define reasonable and technically defensible parameter ranges and modelling assumptions for the use in the STCP. The uncertainties in the radiological releases to the environment can be defined as the degree of current knowledge associated with the magnitude, the timing, duration, and other pertinent characteristics of the release following a severe nuclear reactor accident. These uncertainties can be quantified by probability density functions (PDF) using the Source Term Code Package.

36906 (NUREG/CP—0082-Vol.6, pp 179-184) **RCS natural circulation in a PWR station blackout accident--an application of NRC mechanistic codes.** Han, J.T. Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper discusses the phenomenon of reactor coolant system (RCS) natural circulation in a PWR station blackout accident with the loss of all AC power and auxiliary feedwater (the TMLB′ accident). Existing and future studies performed for the industry and the Nuclear Regulatory Commission (NRC) are summarized in the paper. During the core uncovery and core melt period of the high-pressure TMLB′ accident, multi-dimensional natural circulation of gas flow (steam and other gas such as hydrogen and fission products) is likely to exist in the uncovered core and the upper plenum above. Meanwhile, counter-current gas flow may also exist in the hot leg piping except during the opening of a power-operated relief valve (PORV) or safety relief valve (SRV) on the pressurizer. As a result, some of the core decay heat is transferred to the upper plenum structures and ex-vessel piping and components, and the RCS pressure boundary may be heated to high temperature to challenge structural integrity.

36907 (NUREG/CP—0082-Vol.6, pp 185-208) **MELPROG/TRAC: update and applications.** Henninger, R.J.; Kelly, J.E. (Los Alamos National Lab., NM). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The first complete, coupled, and mechanistic analysis of a core meltdown sequence has been made with MELPROG-PWR/MOD1 and MEL-PROG/TRAC. The sequence analyzed was a station blackout accident for the Surry plant. Through vessel failure, all important aspects of the meltdown sequence were calculated. This version of MELPROG permits a full two-dimensional treatment of the in-vessel phenomena. Natural circulation can thus be modeled. Comparison to one-dimensional MELPROG and MARCH calculations shows that natural circulation reduces the rate of core heating, but increases the rate of heating of upper plenum structures and primary piping. This increased heating can inhibit fission product deposition and may lead to an early failure of the primary system. Because of uncertainty, sensitivity studies were performed to assess the relative importance of modeling assumptions. Changes in the modeling of the initial fuel rod melting and relocation were found to vary the hydrogen source by a factor of 2 and alter the timing of key events. These results imply that accurate and mechanistic modeling is important for severe accident sequence analysis.

36908 (NUREG/CP—0082-Vol.6, pp 209-214) **SCDAP/RELAP5 update and applications.** Allison, C.M.; Berna, G.A.; Cheng, T.C.; Siefken, L.J.; Sheih, A.S.L.; Wagner, R.J. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.6). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The integrated SCDAP/RELAP5 code is being developed by the office of Nuclear Regulatory Research of the USNRC for the purpose of calculating the core damage and fission product transport within the RCS during LWR severe accident events. Activities since October 1985 were concentrated in three areas. The first area, code and model development, resulted in the addition of a $B_4C$ control rod model and a two-dimensional (axial-radial) heat conduction analysis of fuel and control rods. The second area, developmental assessment, evaluated code models using the results of the OECD LOFT FP-2 test and the PBF and ACRR severe fuel damage tests. The third area, user and NRC technical support, resulted in application of the code to analyses of severe accidents in BWRs and PWRs.

36909 (NUREG/CP—0082-Vol.6, pp 215-232) **STCP validation.** Gieseke, J.A.; Curtis, L.A.; Cybulskis, P.; Kogan, V.; Kuhlman, M.R.; Lee, K.W.; Wooton, R.O. (Battelle Northwest Lab., Columbus, OH). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The systematic comparison of Source Term Code Package (STCP) calculations with experimental predictions is being pursued for code validation. The validation activities also include the identification and evaluation of various applicable data. The validation process is expected to provide increased confidence that the STCP will give reasonably accurate predictions of radionuclide source terms under reactor accident conditions. The general data base has been identified and some specific initial comparisons involving both thermal hydraulics and radionuclide transport have been completed. Agreement between experimental results and code predictions is quite good. It has been found that not all of the data expected to be used for validation is understood in sufficient detail to make it useful for this purpose.

36910 (NUREG/CP—0082-Vol.6, pp 233-258) **DCH-1: first direct containment heating experiment in the SURTSEY test facility.** Tarbell, W.W.; Brockmann, J.E.; Pilch, M. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The DCH-1 test was the first experiment performed in the SURTSEY Direct Heating Test Facility. It was designed to provide the experimental data required to understand the phenomena associated with pressurized melt ejection and direct containment heating. The results will be used to develop phenomenological models for large containment response codes. The test involved 20 kg of molten core debris simulant ejected into a 1:10 scale mockup of the Zion reactor cavity. The melt was produced by a metallothermitic reaction of iron oxide and aluminum powders to yield molten iron and alumina. The cavity model was placed so that the emerging debris would propagate directly upwards along the vertical centerline of the chamber. Results from the experiment showed that the dispersed debris caused a rapid pressurization of the chamber atmosphere. Peak pressure from the six transducers ranged from 0.9 to 0.13 MPa (13.4 to 19.4 psig). The time interval from the start of debris ejection to pressure peak was two-three seconds. Post-test debris collection yielded 11.6 kg of material outside the cavity, of which approximately 1.6 kg was attributed to the uptake of oxygen by the iron particles. Mechanical sieving of the recovered debris showed a log-normal size distribution with a mass mean size of 0.55 mm. Aerosol measurements indicated a substantial portion ($\sim$ 5 to 29%) of the displaced mass was in the size range less than 10 $\mu$m.

36911 (NUREG/CP—0082-Vol.6, pp 259-270) **Recent experimental and analytical results of BNL direct containment heating programs.** Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Upton, NY). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The direct containment heating (DCH) scenario involves high-pressure ejection of molten core material from the reactor vessel into the region beneath the vessel and into various subcompartments of the containment building. The stored energy in the melt consists of the sensible energy of melt and the chemical reaction energy of the various components assuming that they can react with either the oxygen or the steam within containment. The metallic phase may first react with steam, if local conditions permit, and thereby produce hydrogen. The hydrogen may then burn at some later time at a different location. In order to predict the containment response, one must follow the melt through the various subcompartments of the containment building, while computing the integrated release of energy from the melt to the containment atmosphere and the quantity of hydrogen produced during the time period that the melt is suspended. The BNL research program in the area of direct containment heating is directed towards the development of a methodology to predict the hydrodynamic, chemical and thermal interactions which could take place in three regions of PWR containment buildings: the reactor cavity, the intermediate compartments (e.g., steam generator room) and the containment dome. Separate effects, scaled experiments are performed related to selected aspects of the DCH problem, and analytical models are developed to characterize the relevant phenomena. A summary of recent progress is presented.

36912 (NUREG/CP—0082-Vol.6, pp 271-292) **Development and applications of the interim direct heating model for the CONTAIN computer code.** Bergeron, K.D.; Carroll, D.E.; Tills, J.L.; Washington, K.E.; Williams, D.C. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A model for Direct Containment Heating has been developed for the CONTAIN code which takes account of the competing processes of melt ejection, steam blowdown, heat transfer among debris, gas and walls, chemical reactions in the debris droplets, intercell gas and debris transport, and de-entrainment of the suspended debris. Calculations of accident sequences with the model have shown that a qualitatively different understanding of the Direct Heating phenomenon emerges when more detailed multi-cell calculations are performed within a system-level containment code, compared to the relatively simplistic single cell, adiabatic calculations which have been used in the past. Results are presented for the TMLB sequence at the Surry and Sequoyah plants, and a sensitivity study for some of the most important uncertain parameters is described.

36913 (NUREG/CP—0082-Vol.6, pp 293-318) **Experimental study of isothermal and boiling liquid jets.** Marshall, B.W. Jr.; Berman, M. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Recent observations inside the Three Mile Island-Unit 2 reactor core have shown that about 20 tons of core material melted and poured into the lower plenum. The core material is believed to have poured through and around the holes in the structural plates, creating jets of molten corium falling through water. The experimental work described in this paper illustrates the coarse-mixing behavior of molten jets of iron/alumina falling through water. Significant fragmentation of the jet occurs for pour diameters of 4 to 16 cm. The breakup of a boiling-jet appears to depend on the generation of steam and is significantly different from liquid-gas or isothermal liquid-liquid systems.

36914 (NUREG/CP—0082-Vol.6, pp 319-356) **Steam explosion energetics.** Theofanous, T.G.; Amarasooriya, W.H.; Abolfadl, M.; Najafi, B.; Lucas, G.E.; Rumble, E. (Univ. of California, Santa Barbara). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The purpose of this presentation is to summarize the results of a study aiming to quantify the likelihood of the $\alpha$-mode containment failure. Key elements of the study include a new probabilistic framework, improved quantification of the fuel quantities possible to premix within the lower plenum, detailed structural analyses of lower plenum failure and associated venting, and new upper head

loading and failure mechanisms. The study is specifically focused on the low pressure core melt scenario and does not consider the effects of multiple explosions. The results lend additional support to the recent conclusions of the Steam Explosion Review Group than the likelihood of the α-mode containment failure is negligible. However, in order to gain fully the advantages of the present approach as a means of leading to convergence of technical judgement it is expected that additional efforts would be required to enrich the basis for and refine the uncertainty bounds of the causal relations introduced here.

36915 (NUREG/CP—0082-Vol.6, pp 357-378) **Recent results in hydrogen research.** Berman, M.; Sherman, M.P.; Wong, C.C. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Progress has been made in the NRC-supported hydrogen research program in three areas: (1) a comparison of the HECTR and MAAP codes; (2) the completion of a series of experiments in the FLAME facility on flame acceleration and the transition from deflagration to detonation; and (3) a qualitative assessment of the potential for local detonations in a reactor containment. There are significant differences between the combustion models in HECTR and MAAP. These modelling differences can result in different predictions of containment pressure and temperature. Recent FLAME experiments have shown that spontaneous transition from deflagration to detonation can take place in hydrogen mixtures that are relatively insensitive. The presence of obstacles and the degree of confinement also play important roles in the likelihood of this transition. Information obtained during these experiments has been combined with other data and subjective judgments to develop a qualitative methodology for estimating the probability of local detonations. This methodology has been applied to the Bellefonte containment for some accident scenarios.

36916 (NUREG/CP—0082-Vol.6, pp 379-392) **Large model tests for containment performance and separate effects tests for penetrations.** von Riesemann, W.A. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.6). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The performance of light water reactor (LWR) containment systems when subjected to loadings produced by hypothetical severe accidents is being investigated in several programs that are funded by the US Nuclear Regulatory Commission (NRC). The loadings on the containment from severe accidents result in pressures and temperatures which may be beyond the ones used for design. Failure may occur in any one of the elements that constitute the containment boundary (the containment shell, the penetrations, the isolation system, or the basemat). In designing the containment system, linear elastic methods or design code rules or both are used. In either case it is difficult to extrapolate the results to predict with confidence the loads that would cause failure. Therefore, experimental methods are being used to determine the response and the failure levels of the components of the system. Depending on the component, either full-size or scale models are used. It is important to note that the scale model experiments are to be used to validate predictive methods. That is, the recorded failure levels are not to be extrapolated to full size nor interpreted to be generic. This paper discusses the performance of three components of the containment system; namely, the containment structure and the mechanical and electrical penetrations.

36917 (NUREG/CP—0082-Vol.6, pp 393-413) **Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel.** Tsuge, A.; Kawanishi, K.; Kuwabara, K.; Fujimoto, T.; Hirao, Y.; Nakamori, N.; Ogata, J.; Ukai, O.; Kooriyama, T. (Mitsubishi Heavy Industries, Ltd., Takasago, Japan). Feb 1987. (CONF-8610135—Vol.6).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper presents the overview of the extensive research and development activities on small break LOCA thermal hydraulics and the hydrogen mixing within the containment vessel after the LOCA carried out by PWR industry group in Japan. A new Computer Analysis Program of Natural Circulation for multiloop systems, CANAC-II has been developed and qualified based upon comprehensive test program. CANAC-II has the capability of predicting the realistic thermal hydraulic transient of the small break LOCA with the shorter computer running time than the real time. A new Mixing Analysis Program of Hydrogen within the containment vessel after the LOCA has been developed and qualified based on large scale containment vessel model having 26 subcompartments. MAPHY Code was applied to the prototypical containment vessel, proving the good mixing of hydrogen between the subcompartments with no hot spot of hydrogen concentration.

36918 (NUREG/CR—4098) **Seismic-fragility tests of new and accelerated-aged Class 1E battery cells.** Bonzon, L.L.; Janis, W.J.; Black, D.A.; Paulsen, G.A. (Sandia National Labs., Albuquerque, NM (USA); Ontario Hydro, Toronto (Canada). Research Center; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Jan 1987. Contract AC04-76DP00789. 135p. (SAND—84-2631). NTIS, PC A07/MF A01 - GPO. File Number TI87008181.

The seismic-fragility response of naturally-aged nuclear station safety-related batteries is of interest for two reasons: (1) to determine actual failure modes and thresholds and (2) to determine the validity of using the electrical capacity of individual cells as an indicator of the potential survivability of a battery given a seismic event. Prior reports in this series discussed the seismic-fragility tests and results for three specific naturally-aged cell types: 12-year old NCX-2250, 10-year old LCU-13, and 10-year old FHC-19. This report focuses on the complementary approach, namely, the seismic-fragility response of accelerated-aged batteries. Of particular interest is the degree to which such approaches accurately reproduce the actual failure modes and thresholds. In these tests the significant aging effects observed, in terms of seismic survivability, were: embrittlement of cell cases, positive bus material and positive plate grids; and excessive sulphation of positive plate active material causing hardening and expansion of positive plates. The IEEE Standard 535 accelerated aging method successfully reproduced seismically significant aging effects in new cells but accelerated grid embrittlement an estimated five years beyond the conditional age of other components.

36919 (NUREG/CR—4165) **Severe Accident Sequence Analysis Program: Anticipated transient without scram simulations for Browns Ferry Nuclear Plant Unit 1.** Dallman, R.J.; Gottula, R.C.; Holcomb, E.E.; Jouse, W.C.; Wagoner, S.R.; Wheatley, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1987. Contract AC07-76ID01570. 89p. (EGG—2379). NTIS, PC A05/MF A01 - GPO. File Number TI87010676.

An analysis of five anticipated transients without scram (ATWS) was conducted at the Idaho National Engineering Laboratory (INEL). The five detailed deterministic simulations of postulated ATWS sequences were initiated from a main steamline isolation valve (MSIV) closure. The subject of the analysis was the Browns Ferry Nuclear Plant Unit 1, a boiling water reactor (BWR) of the BWR/4 product line with a Mark I containment. The simulations yielded insights to the possible consequences resulting from a MSIV closure ATWS. An evaluation of the effects of plant safety systems and operator actions on accident progression and mitigation is presented.

36920 (NUREG/CR—4617) **Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures.** Meyer, O.R.; Blackman, H.S.; Ford, R.E.; Haney, L.N. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Risk Analysis and Operations). Mar 1987. Contract AC07-76ID01570. 42p. (EGG—2456). NTIS, PC E04/MF A01 - GPO. File Number TI87007999.

Includes 1 sheet of 24x reduction microfiche.

The implementation of upgraded emergency operating procedures (EOPs) by the nuclear utilities supports Three Mile Island (TMI) Action Plan Items I.C.1 and I.C.9. This is the final report of a research project directed at assessing the costs and benefits of the resultant EOPs. A dual methodology was used to assess effectiveness; experimental and onsite data collection. A simulator-based, laboratory experiment was conducted, which was designed to be sensitive to changes in operator effectiveness using function oriented EOPs versus event based EOPs. The onsite data collected were related to the effectiveness of upgraded EOPs as implemented with all attributes (e.g., function oriented, human factored, etc.). The acceptance of the upgraded EOPs by the control room operators was also measured. A cost/benefit ratio for upgraded EOPs was estimated per regulatory analysis guidelines. Summary conclusions are disclosed as to the ultimate benefits of the upgraded EOP program for the regulation of the safety of commercial nuclear power plants.

36921 **(NUREG/CR—4674-Vol.3) Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B.** Minarick, J.W.; Harris, J.D.; Austin, P.N.; Cletcher, J.W.; Hagen, E.W. (Oak Ridge National Lab., TN (USA); Science Applications International Corp., Las Vegas, NV (USA); Professional Analysis, Inc., Oak Ridge, TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). May 1987. Contract AC05-84OR21400. 129p. (ORNL/NOAC—232-Vol.3). NTIS, PC A07/MF A01. File Number TI87010610.

Forty-eight operational events, reported in LERs and occurring at commercial LWRs during 1984 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of the work presented in earlier volumes in this series, which evaluated the 1969-1981 and 1985 events. The report sequentially discusses (1) the general rationale for this study, (2) the program methods for review and documentation of operational events as precursors, (3) the use of the conditional probability of subsequent severe core-damage estimates to rank precursor events, and (4) initial conclusions from the assessment of 1984 events.

36922 **(NUREG/CR—4674-Vol.4) Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E.** Minarick, J.W.; Harris, J.D.; Austin, P.N.; Cletcher, J.W.; Hagen, E.W. (Oak Ridge National Lab., TN (USA); Science Applications International Corp., Las Vegas, NV (USA); Professional Analysis, Inc., Oak Ridge, TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). May 1987. Contract AC05-84OR21400. 534p. (ORNL/NOAC—232-Vol.4). NTIS, PC A23 - GPO. File Number DE87010611.

This report contains listings of events that are of potential concern from a core damage standpoint. From all of the operational events of 1984, forty-seven (47) precursors were selected. The selection criteria is provided, and a description sheet and a conditional core damage calculation are included for each selected precursor. A copy of associated Licensee Event Reports (LER) for each selected precursor also is provided in this report. (FI)

36923 **(NUREG/CR—4679) Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review.** Nowlen, S.P. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Feb 1987. Contract AC04-76DP00789. 166p. (SAND—86-0311). NTIS, PC A08/MF A01 - GPO. File Number TI87010662.

This report presents the findings of a task in which currently available fire research literature was reviewed for quantitative data on the burning characteristics of combustible materials that are found in nuclear power plants. The materials considered for which quantitative data were available include cable insulation materials, flammable liquids, furniture, trash and general refuse, and wood and wood products. A total of 90 figures and tables, taken primarily from the referenced works, which summarize the available quantitative fire characterization information for these materials is presented.

36924 **(NUREG/CR—4681) Enclosure environment characterization testing for the base line validation of computer fire simulation codes.** Nowlen, S.P. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Mar 1987. Contract AC04-76DP00789. 79p. (SAND—86-1296). NTIS, PC A05/MF A01 - GPO. File Number TI87010663.

This report describes a series of fire tests conducted under the direction of Sandia National Laboratories for the US Nuclear Regulatory Commission. The primary purpose of these tests was to provide data against which to validate computer fire environment simulation models to be used in the analysis of nuclear power plant enclosure fire situations. Examples of the data gathered during three of the tests are presented, though the primary objective of this report is to provide a timely description of the test effort itself. These tests were conducted in an enclosure measuring 60x40x20 feet constructed at the Factory Mutual Research Corporation fires test facility in Rhode Island. All of the tests utilized forced ventilation conditions. The ventilation system was designed to simulate typical nuclear power plant installation practices and ventilation rates. A total of 22 tests using simple gas burner, heptane pool, methanol pool, and PMMA solid fires was conducted. Four of these tests were conducted with a full-scale control room mockup in place. Parameters varied during testing were fire intensity, enclosure ventilation rate, and fire location. Data gathered include air temperatures, air velocities, radiative and convective heat flux levels, optical smoke densities, inner and outer enclosure surface temperatures, enclosure surface heat flux levels, and gas concentrations within the enclosure in the exhaust stream.

36925 **(NUREG/CR—4772) Accident Sequence Evaluation Program: Human reliability analysis procedure.** Swain, A.D. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Feb 1987. Contract AC04-76DP00789. 165p. (SAND—86-1996). NTIS, PC A08/MF A01 - GPO. File Number TI87010664.

This document presents a shortened version of the procedure, models, and data for human reliability analysis (HRA) which are presented in the Handbook of Human Reliability Analysis With emphasis on Nuclear Power Plant Applications (NUREG/CR-1278, August 1983). This shortened version was prepared and tried out as part of the Accident Sequence Evaluation Program (ASEP) funded by the US Nuclear Regulatory Commission and managed by Sandia National Laboratories. The intent of this new HRA procedure, called the "ASEP HRA Procedure," is to enable systems analysts, with minimal support from experts in human reliability analysis, to make estimates of human error probabilities and other human performance characteristics which are sufficiently accurate for many probabilistic risk assessments. The ASEP HRA Procedure consists of a Pre-Accident Screening HRA, a Pre-Accident Nominal HRA, a Post-Accident Screening HRA, and a Post-Accident Nominal HRA. The procedure in this document includes changes made after tryout and evaluation of the procedure in four nuclear power plants by four different systems analysts and related personnel, including human reliability specialists. The changes consist of some additional explanatory material (including examples), and more detailed definitions of some of the terms. 42 refs.

36926 **(NUREG/CR—4783) Analysis of balance-of-plant regulatory issues: Final report.** Lay, R.; Ettlinger, L.; Seth, S.; Malone, G.; Sullivan, R.; Skinner, L.; Schaefer, P. (Mitre Corp., McLean, VA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jan 1987. 177p. (MTR—86W00213). NTIS, PC A09/MF A01 - GPO. File Number TI87900769.

The MITRE Corporation, under contract to the US Nuclear Regulatory Commission (NRC), has examined certain regulatory and performance aspects of the conventional, or power conversion, side of nuclear plants, often referred to as the Balance-of-Plant. This report includes: MITRE's characterization and analysis of the

Balance-of-Plant failures; a perspective on the safety significance of these failures; a description of current NRC activities and industry initiatives that have the potential to reduce these failures; and the formulation of a set of recommendations for NRC's consideration in addressing the safety issues raised by the Balance-of-Plant. In general, the Balance-of-Plant problems represent the most frequent reason for unanticipated plant shutdowns, and they compromise safety. The NRC needs to look at the total power plant facility as a system, and provide the same level of attention to reducing challenges to the plant safety systems as it does to responding and mitigating those challenges. MITRE believes that this can be accomplished within the context of NRC's present regulatory posture.

36927 **(NUREG/CR—4830) MELCOR validation and verification: 1986 papers.** Leigh, C.D. (ed.). (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Mar 1987. Contract AC04-76DP00789. 221p. (SAND—86-2689). NTIS, PC A10/MF A01 - GPO. File Number TI87010665.

Separate abstracts were prepared for the individual papers in this report. (JDB)

36928 **(NUREG/CR—4903-Vol.3) Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review.** Luco, J.E. (Structural and Earthquake Engineering Consultants, Inc., Arcadia, CA (USA); California Univ., San Diego (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 177p. NTIS, PC A09/MF A01 - GPO. File Number TI87900768.

The solutions available for a number of dynamic dislocation fault models are examined in an attempt at establishing some of the expected characteristics of earthquake ground motion in the near-source region. In particular, solutions for two-dimensional anti-plane shear and plane-strain models as well as for three-dimensional fault models in full space, uniform half-space and layered half-space media are reviewed.

36929 **(SAND—86-2869C) US Department of Energy Nuclear Plant Life Extension Program.** DuCharme, A.R.; Carlson, D.D.; Harrison, D.L. (Sandia National Labs., Albuquerque, NM (USA); USDOE, Washington, DC). 1987. Contract AC04-76DP00789. 11p. (CONF-870756—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010494.

From Symposium on aging and maintenance; Vienna, Austria (3 Jul 1987).

Extended lifetime operations and renewal of nuclear power plant licenses will be accomplished in the US through an industry wide effort involving the Electric Power Research Institute (EPRI), utilities, the Atomic Industrial Forum (AIF), code and standard committee, the Nuclear Regulatory Commission (NRC) and the DOE. The collective industry effort is being coordinated by the Nuclear Plant Life Extension (NUPLEX) Steering Committee. As an important first step in plant life extension research, the DOE, EPRI and plant owners are supporting two pilot plant studies. These studies thus far indicate no major obstacles to operating considerably longer than 40 years. Additional analysis and R & D are needed, however, to resolve generic uncertainties of degradation processes and to develop the technology for improved inspections, the repair and replacement of aged components and preventive alternatives. The DOE is currently supporting more broadly based variance studies to develop the technical basis for the extended life of specific critical components. Economic studies are also in process to facilitate decision-making for life extension on a national and regional basis. Further R & D is also under way on the predictive performance of key components affecting plant safety and availability. The DOE is also investigating the longer term deterioration of critical cables. Additional aspects of DOE research address data requirements for life extension as well as work to assist NRC policy development.

36930 **(SAND—87-0184) Critical components and monitoring techniques for Nuclear Power Plant life extension.** DeBey, T.M.; Sanders, G.A.; Carlson, D.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010531.

The Department of Energy, as part of the point DOE/EPRI life extension program, has initiated a program to develop approaches for effectively monitoring the performance of components key to plant safety and availability during nuclear plant operation past 40 years. Development and implementation of such approaches will assure continued safe and economic plant performance. This paper describes the results of initial efforts that explored the use of systems modeling techniques to identify components which, if their reliability degrades or improves, could most impact safety. Results of an application of these techniques to the Surry Nuclear Power Plant and a comparison with the pilot plant categorization are presented. For selected types of components, the degradation and failure mechanisms are explored and state-of-the-art monitoring techniques are evaluated.

36931 **(UCID—20466) Sensitivity of piping seismic responses to input factors.** O'Connell, W.J. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010707.

This report summarizes the sensitivity of peak dynamic seismic responses to input parameters. The responses have been modeled and calculated for the Zion Unit 1 plant as part of a seismic probabilistic risk assessment (PRA) performed by the US NRC Seismic Safety Margins Research Program (SSMRP). The SSMRP was supported by the US NRC Office of Nuclear Regulatory Research. Two sensitivity topics motivated the study. The first is the sensitivity of piping response to the mean value of piping damping. The second is the sensitivity of all the responses to the earthquake and model input parameters including soil, structure and piping parameters; this information is required for another study, the sensitivity of the plant system response (in terms of risk) to these dynamic input parameters and to other input factors. We evaluate the response sensitivities by performing a linear regression analysis (LRA) of the computer code SMACS. With SMACS we have a detailed model of the Zion plant and of the important dynamic processes in the soil, structures and piping systems. The qualitative results change with the location of the individual response. Different responses are in locations where the many potential influences have different effectiveness. The results give an overview of the complexity of the seismic dyanmic response of a plant. Within the diversity trends are evident in the influences of the input variables on the responses.

36932 **(UCID—20475) Importance and sensitivity of parameters affecting the Zion Seismic Risk.** George, L.L.; O'Connell, W.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1985. Contract W-7405-ENG-48. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010706.

This report presents the results of a study on the importance and sensitivity of structures, systems, equipment, components and design parameters used in the Zion Seismic Risk Calculations. This study is part of the Seismic Safety Margins Research Program (SSMRP) supported by the NRC Office of Nuclear Regulatory Research. The objective of this study is to provide the NRC with results on the importance and sensitivity of parameters used to evaluate seismic risk. These results can assist the NRC in making decisions dealing with the allocation of research resources on seismic issues. This study uses marginal analysis in addition to importance and sensitivity analysis to identify subject areas (input parameter areas) for improvements that reduce risk, estimate how much the improvement dfforts reduce risk, and rank the subject areas for improvements. Importance analysis identifies the systems, components, and parameters that are important to risk. Sensitivity analysis estimates the change in risk per unit improvement. Marginal analysis indicates the reduction in risk or uncertainty for improvement effort made in each subject area. The results described in this study were generated using the SEISIM (Systematic Evaluation of Important Safety Improvement Measures) and CHAIN computer

codes. Part 1 of the SEISIM computer code generated the failure probabilities and risk values. Part 2 of SEISIM, along with the CHAIN computer code, generated the importance and sensitivity measures.

36933 **Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels.** Chang, L.K.; Mohr, D.; Feldman, E.E.; Betten, P.R.; Planchon, H.P. (Argonne National Lab., Argonne, IL 60439). pp 471-484 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—). Contract W-31-109-ENG-38.

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

A series of eight loss-of-flow (LOF) tests have been conducted in EBR-II to study the transition between forced and natural convective flows following a variety of loss-of-primary-pumping power conditions from decay heat levels. Comparisons of measurements and pretest/posttest predictions were made on a selected test. Good agreements between measurements and predictions was found prior to and just after the flow reaching its minimum, but the agreement is not as good after that point. The temperature are consistent with the flow response and the assumed decay power. The measured results indicate that the flows of driver and the instrumented subassemblies are too much in the analytical model in the natural convective region. Although a parametric study on secondary flow, turbulent-laminar flow transition, heat transfer ability of the intermediate heat exchange at low flow and flow mixing in the primary tank has been performed to determine their effects on the flow, it is still unknown the cause of the discrepancy at very low flow level.

36934 **The ultimate safe (U.S.) reactor.** Gat, U.; Daugherty, S.R. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 435-446 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

The Ultimate Safe (U.S.) Reactor is a reactor that eliminates the customary safety concerns of nuclear fission reactors. The U.S. Reactor has an insignificant source term and no reasonable criticality accident. Furthermore, the negligible residual after-heat in the reactor renders its shutdown capability comparable or superior to conventional power sources in that no actions or precautions are required following a shutdown of power. The U.S. Reactor utilizes two principles to achieve ultimate safety. Fission products are continuously removed at the rate they are produced, thus retaining the inherent source term at an insignificant level. The reactor is operated with no excess criticality, hence no criticality accident is reasonably possible. The reactor is controlled safely by its negative temperature coefficient. The reactor maintains criticality by an internal breeding ratio that is trimmed to be exactly one. To facilitate the continuous fission product removal, the U.S. Reactor requires a fluid fuel and on-line, continuous fuel processing. Molten salt fuel was selected for its well-known beneficial properties: low vapor pressure at high temperature; adequate solubility of uranium and thorium as fluorides; good compatibility with structural materials; absence of irradiation damage; high negative temperature coefficient; and amply developed technology and experience. The passive inherent safety features of the U.S. Reactor make it a potentially economical competitor with high reliability, thereby making it an attractive option for future energy generation.

36935 **Hot tests of the small portable arc saw using an electromechanical manipulator.** Deichelbohrer, P.R. (Dept. of Development Engineering, Rockwell Hanford Operations, Richland, WA 99352). pp 485-506 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

A hand-held portable arc saw was demonstrated in 1982. Known as the Small Portable Arc Saw (SPARCS), it weighed less than 15-lb and could cut metal sheet up to 1/2-in thick. From the hand-held SPARCS, a manipulator-handled model was developed for use in decommissioning operations by Pacific Northwest Laboratory (PNL). During cold tests, the SPARCS, which was maneuvered with a mechanical, master-slave manipulator, cut 1-in thick stainless steel plate. The decommissioning method of PNL depended principally on a plasma cutting torch for size reduction. The SPARCS unit was installed in the cell to assist the plasma torch. At present, use of the SPARCS in this project has not been necessary, and it has not been operated in the cell. The plasma cutting torch is a widely used tool for size reduction; the torch can cut stainless steel and heavy material, is lightweight, and is easy to handle with manipulators. Some shortcomings, however, have been reported; for example, cutting pipe, laminates, or forms with hollow cross sections (e.g., unistrut) is sometimes cumbersome. The stand-off spacing required is another constraint. The torch tip must be spaced approximately 1/2-in from the work to achieve proper cutting action. During cutting, this spacing requires accurate control of the torch. The manipulator operator must have significant skill to achieve this control. Test results to date show that the arc saw's ability to cut heavy, hard, and inert metal compares favorably with the performance of the plasma torch. The arc saw offers the further advantages of cutting hollow cross-section forms without special procedures, and of cutting without stand-off spacing.

# 25 ENERGY STORAGE

*REFER ALSO TO CITATION(S) 36786*

36936 **(NP—7770119) Applications of energy storage systems in lifting gears.** Petry, H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Konstruktion und Fertigung). 14 Jun 1984. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770119.

After a general analysis of the applicability of energy storage systems in materials handling, a model describing time-dependent operating processes was developed and implemented on a computer. The model permits a detailed treatment of complex mechanical and electric driving systems, with energy storage or without it, from the available design and construction data. The simulation method was specially adapted to lifting gears with ramp-type load velocity curves.

## 2504 Capacitor Banks

36937 **(AD-A—179273/8/XAB) Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986.** Clark, C.F. (CeramPhysics, Inc., Westerville, OH (USA)). 23 Jan 1986. 11p. NTIS, PC A02/MF A01.

Intial microstructure studies of multilayer capacitors (MLC) were completed and show the presence of a second phase that can be correlated with the state switching phenomena. Most other planned MLC sets embodying a large number of parameter variations were made and are currently under evaluation. Thermal properties of MLC's were measured and a heat-flow model has been developed to describe temperature measured and provide clues as to the origin of the unusual phenomena associated with this material. Instrumentation was developed for computer-controlled voltage-breakdown testing at 77 K.

## 2506 Thermal

36938 **(EUR—10836-EN) Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report.** Visser, H. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 165p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.; HP 1000.

This report contains the development and testing of a component model which is compatible with a large computer program for the simulation of solar energy systems, the so-called TRNSYS transient simulation program. The component model holds the nu-

merical description of two different short term heat-storage vessels. In both vessels the energy is stored in the latent heat of phase-change materials. In one tank the phase-change material is packed in cylinders and the heat-transfer fluid flows parallel to it. In the other tank, pipes containing the fluid are embedded in the phase-change material. Both configurations can be described in a cylindrical way, resulting in a two-dimensional mathematical model. The basis of the model is the enthalpy method in which the transition range of the phase-change material is introduced. Furthermore, special attention is paid to the modelling of the cylinder and pipe wall, the energy transport between the heat-transfer fluid and these walls, the energy loss into the environment and the special requirements of the TRNSYS program. The resulting set of equations is solved by means of the Gauss-Seidel iteration process.

36939 **(PNL—6251) Thermal Energy Storage Evaluation Program: 1986 annual report.** Drost, M.K.; Bates, J.M.; Brown, D.R.; Weijo, R.O. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012070.

The Thermal Energy Storage Evaluation Program activities were initiated to provide economic planning, technical assessment and field testing support for the thermal energy storage program, as well as management of the overall program for the DOE. Economic planning included two assessment studies. In technical assessment, issues that might affect an assessment were outlined for the development of a standard methodology to conduct assessments; work is underway to establish "market-based" cost and performance goals for cool storage technologies in residential applications; planning has begun for investigation of benefits in incorporating aquifer thermal energy storage with heat pumps; and plans are being formulated to evaluate the potential benefit of using aquifer thermal energy storage to augment power plant cooling. Field testing to develop technologies for the recovery and reuse of industrial waste heat began with the instrumentation design for the ceramic/salt matrix in an operating brick-making plant. Work in advanced studies by Lawrence Berkeley Laboratory continued on thermochemical conversion and storage using small particles as the heat exchanger catalyst. In $SO_3$ dissociation experiments at 645°C using light and dark conditions, results clearly demonstrated the benefit in directly radiantly heating the catalyst to accomplish the endothermic step of a thermochemical storage reaction.

## 2509 Batteries

36940 **(AD-A—179086/4/XAB) Aircraft battery state of charge and charge-control system. Interim report, 1 July 1985-30 June 1986.** Viswanathan, S.; Charkey, A. (Energy Research Corp., Danbury, CT (USA) ). Apr 1987. 71p. NTIS, PC A04/MF A01.

This Interim Report describes work done by Energy Research Corporation (ERC) in developing an aircraft battery state-of-charge indicator and charge control system. The basis for this system, developed by ERC, is a nickel-oxygen ($NiO_2$) pilot cell (0.374 Ah). This pilot cell is cycled in tandem with a nickel-cadmium battery. The oxygen pressure of the pilot cell is used to determine and control the state-of-charge of the nickel-cadmium battery. Nickel-cadmium batteries from different manufacturers were cycled using this pilot cell charge indication and control system. The performance of the pilot cell and a nickel-cadmium battery as a function of temperature were separately determined.

36941 **(CONF-870804—13) Molten salt battery advances.** Kaun, T.D.; Redey, L.; Nelson, P.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011402.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

In recent years, development of Li-alloy/metal sulfide cells with molten-salt electrolyte for high performance applications has concentrated on improvement of the electrode performance and cell capacity stability. New electrochemistries and porous electrode compositions have provided a strong foundation for further development of Li-alloy/dense upper-plateau (U.P.) $FeS_2$ (1.75 V) cells, as well as Li-alloy/FeS (1.32V) cells. (U.P. $FeS_2$ refers to the discharge reaction of $FeS_2$ to $Li_2FeS_2$.) A lithium-limited FeS cell has demonstrated 100 Wh/kg at a 3-h rate and 100 W/kg at 80% depth of discharge (DOD), while a dense U.P. $FeS_2$ cell is now capable of 175 Wh/kg at a 4-h rate and 200 W/kg at 80% DOD. Both types have demonstrated stable cycle life of greater than 400 cycles, with 1000 cycle-life expectancy. Earlier $FeS_2$ cells suffered from an appreciable ((0.1 to 0.25%/cycle) cell capacity decline rate, which has been eliminated by recent innovations. A new molten-salt electrolyte, LiCl-LiBr-KBr (m.p. 310°C), improved performance and allowed a lower cell operating temperature of 400°C, from 425 to 450°C for earlier cells. Cell design flexibility, along with the high conductivity electrolyte and high energy density electrodes, offers a broad range of capability. A bipolar design with U.P. $FeS_2$ electrodes is projected to provide specific energy of 200 Wh/kg and specific power up to 5 kW/kg. Preliminary tests with a new cell design for reduced materials costs showed that the Li-Al/U.P. $FeS_2$ couple was capable of high specific energy in a rod-electrode configuration.

36942 **(CONF-870804—14) Power performance of high-temperature Li-alloy/$FeS_2$ bipolar cells in short pulses.** Redey, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011388.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A new class of the lithium-alloy/metal-disulfide secondary cells - cells that are characterized by a thin, bipolar cell construction, and very high specific power and power-to-energy ratio (termed "galvanic capacitors") - has been developed and studied with regard to their power capability and operational principles. Several versions of these cells (varied in their chemistry and geometry) were investigated in 0.1- to 1000-ms high-intensity (3 to 50 A/$cm^2$) current pulses. A 25-W/$cm^2$ peak power, 200-kW/$dm^3$ power density, and 350-Wh/$dm^3$ energy density have been achieved in repetitive 1- to 10-ms pulses and in several cycles for Li-Al/$FeS_2$ galvanic-capacitor cells. In investigating the operational principles of this system, we have found that (1) the power of well-designed battery cells is controlled by the ohmic resistances of the cell components when the current pulses are shortened to less than 10 ms, and (2) the voltage loss vs current density relationship at any specified state of discharge is nearly linear if the voltage-loss values are compared at identical times of the pulses of the different current densities. On the basis of the latter finding, a precise and simple way is proposed to measure, characterize, and compare various power-performance indicators of bipolar battery cells.

36943 **(NEI-DK—21) Copper ion-conducting materials in chloride melts.** Christensen, E. (Danmarks Tekniske Hoejskole, Lyngby. Kemisk Lab. A; Danmarks Tekniske Hoejskole, Lyngby. Inst. for Mineralindustri). 1986. 317p. (In Danish). NTIS (US Sales Only), PC A14. File Number DE87752474.

The crystal structure of Nasicon (the solid solution Na/sub 1+x/Zr/sub 2/Si/sub x/P/sub 3-x/0/sub 12/, 0 /sup </=/sup /x /sup </=/sup /3) is described. The ionic conductivity and thermal expansion is discussed on the basis of the given structure. Relevant phase relations in the Na/sub 2/0-Zr0/sub 2/-Si0/sub 2/-P/sub 2/0/sub 5/- and Cu/sub 2/0-Cu0-Zr0/sub 2/-Si0/sub 2/-P/sub 2/0/sub 5/-systems reported in the literature, are discussed. A method based on alkoxide derived gels was used for making raw materials for manufacturing of ceramic materials. The principles in preparing such gels are outlined. Homogeneous gels of Nacicon compositions were made from alcoholic solutions containing H/sub 3/PO/sub 4/, Si(OC/sub 2/H/sub 5/)/sub 4/, Zr(OC/sub 3/H/sub 7/)/sub 4/ and NaOCH/sub 3/. The gelling process was started when the alkoxides were activated by addition of water. The transitions, when the gels are dried, ground to powders, and then heated to the sintering temperature, are investigated by thermal analysis (DTA and TG), and by X-ray diffraction. Stirring, together with addition of water during the evaporation of the liquid phase, causes collapse of the gel structure and formation of closed pores containing organic material. This material can only be removed by the calcination of the dried and ground gels, if the temperature is raised to at least 700 deg. C. A copper coumpound with the Nasicon structure, CuZr/sub 2/P/sub 3/O/sub 12/, is formed only at composi-

tions with a high phosphorous content. The effetcs of varying heating rate during sintering of Nasicon ceramics are investigated by determination of porosity and by scanning electron microscopy. A high rate of heating resulted in a lower porosity. On the other hand in these cases there are found zirconium oxide crystals probably forming centers for the formation of Nasicon crystals.

36944 **(SAND—86-1266) Exploratory Battery Technology Development and Testing report for 1985.** Magnani, N.J.; Clark, R.P.; Braithwaite, J.W.; Bush, D.M.; Butler, P.C.; Freese, J.M.; Grothaus, K.R.; Murphy, K.D.; Shoemaker, P.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012505.

Sandia National Laboratories, Albuquerque, has been designated as Lead Center for the Exploratory Battery Technology Development and Testing Project, which is sponsored by the US DOE's Office of Energy Storage and Distribution. In this capacity, Sandia is responsible for the engineering development of advanced rechargeable batteries for both mobile and stationary energy storage applications. This report details the technical achievements realized in pursuit of the Lead Center's goals during calendar year 1985. They are divided into: aqueous battery development, nonaqueous battery development, battery technology evaluation, technology improvement, and project analysis.

36945 **(SAND—87-0393) Development of CABAL [calcium-boro-aluminate] glasses for use in lithium ambient-temperature batteries.** Watkins, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01. File Number DE87011582.

Calcium-boro-aluminate (CABAL) glasses have been developed for use as electrically insulating sealing glasses in lithium ambient-temperature batteries. CABAL glasses have superior corrosion resistance in lithium/electrolyte environments relative to TA-23, and battery lifetimes are now being projected beyond 25 y. In addition, these glasses require much lower melting and sealing temperatures than TA-23. This report outlines the evolution of the CABAL glass technology at Sandia, from original composition selection to identification of the optimum CABAL-12 composition. Seal processing including commercial glass fabrication, mechanical testing, and microstructural evaluation are discussed, and the results of our initial technology transfer efforts are summarized.

36946 **(SAND—87-7115C) Zinc-bromine battery development.** Zagrodnik, J.P.; Eskra, M.D. (Johnson Controls, Inc., Milwaukee, WI (USA); Sandia National Labs., Albuquerque, NM (USA)). 10 Aug 1987. Contract AC04-76DP00789. 6p. (CONF-870804—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009503.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A 20 kWh electric vehicle battery, Z20-low profile, was assembled and tested as part of a contract sponsored by Sandia National Laboratories (SNL). Cycling included capacity tests, power tests, and standing self-discharge tests. A 20 kWH load-leveling module was also designed, assembled, and tested at the recently completed load management test facility at JCI. Two 21 kWh battery systems were constructed and tested in a modified full size Dodge van. This was the first integrated demonstration of a zinc-bromine battery in a road worthy vehicle. The vehicle was equipped with full instrumentation to study the battery's characteristics under actual driving conditions.

36947 **Batteries for hybrid vehicles or other high-power applications.** Miller, J.F.; Lee, J.; Christianson, C.C. (Argonne National Lab., IL, USA). *Electric Vehicle Developments;* 6: No. 2, 51-57(Apr 1987).

Argonne National Laboratory conducted a study to identify promising battery designs for application in future hybrid vehicles (HVs). A preliminary set of battery requirements for Hvs was established using information available from previous studies and also by contacting potential HV developers worldwide. The consensus of the information obtained indicated that, as compared with the electric vehicle battery, the HV battery will be smaller and lighter, must have higher power capability per unit weight and will, on the average, be discharged at higher rates. Based upon preliminary battery requirements, many different battery technologies proposed for the hybrid-vehicle mission were evaluated. Although no existing battery presently developed satisfies all of the preliminary requirements, the analysis has shown that several battery types, with appropriate redesign and development, are good candidates for meeting the hybrid-vehicle application requirements.

36948 **Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K.** Simonson, J.M.; Roy, R.N.; Gibbons, J.J. (Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN). *Journal of Chemical and Engineering Data;* 32: No. 1, 41-44(Jan 1987). Contract AC05-84OR21400.

Potentials for the cell without liquid junction H/sub 2/,Pt vertical bar K/sub 2/CO/sub 3/(m/sub 1/),KHCO/sub 3/(m/sub 2/),KCl(m/sub 3/) vertical bar AgCl,Ag are reported over a wide range of ionic strengths at temperatures to 368.15 K. Analysis of these results with the ion interaction model shows that only very minor changes in the previously reported temperature dependence of the potassium carbonate interaction parameters are required to represent the higher temperature data. Activity and osmotic coefficients for solutions with stoichiometrically equal carbonate and bicarbonate molalities are calculated from 338 to 368 K.

# 29 ENERGY PLANNING AND POLICY

*REFER ALSO TO CITATION(S) 36750*

## 2901 Energy Analysis And Modeling

*REFER ALSO TO CITATION(S) 36979*

36949 **(DOE/EIA—M023) Documentation of the integrating module and stock module of the intermediate future forecasting system.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1987. 119p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87011712.

This report describes the central integrating module (MAIN) of the Intermediate Future Forecasting System (IFFS) that was used to produce the energy forecasts published in the Annual Energy Outlook 1986. IFFS is a partial equilibrium model of the energy markets. The model consists of four supply modules, a stock module, a macroeconomic module, five demand modules, a benchmark integration module, and the central integrating module whose primary function is to direct the execution sequence of the other modules. A brief description is given of the total system, but the focus of the report is on the integrating module. In addition, two supporting programs for IFFS, the run submission and the reporting systems, are described briefly. IFFS is a partial equilibrium model of domestic energy supply and demand. Energy markets, as represented in the model, correspond generally to the energy flow in the United States. The model has a representation of energy supply, conversion, and demand. IFFS projects the energy market on an annual basis; that is, the model is used to solve an equilibrium in each year before moving on to the next. The primary design feature of IFFS is its modularity. The model is organized by fuels - crude and refined oil products, natural gas, coal, and electricity - for supply, and by end-use sectors - residential, commercial, transportation, industrial, and industrial minor fuels - for demand. The individual modules vary in the depth of their structural representation. 22 refs.

36950 **(IIUG-rep—85-11) Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning.** Woodward, A.E. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1985. 65p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87770176.

In the United States, where federal support for energy conservation vaccilates, the opportunity for local innovation is great. The community of Davis in California provides a well-known ex-

ample of the potentials for local energy innovation. In this paper, the processes behind innovation are analyzed, looking at the importance of grassroots organizing for overcoming opposition. Davis is a particularly appropriate case, as it demonstrates how to go from a radical idea to implementation, and it shows how to survive the first wave of innovation and continue to generate new ideas. We analyze Davis, here, by first presenting the structural context of innovation, briefly describing the federal and state policies that encourage or constrain energy action. We then look at the community of Davis itself and analyze the innovation process in planning and conservation. We conclude with a discussion of the implications of the Davis experience for other communities, and the future in a community where the 'easy' energy innovations have been made.

36951 **(IIUG-rep—86-8) Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden.** Woodward, A.E. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 135p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87770177.

The potential for innovation in the energy sector is particularly high in Sweden. This study contrasts the cases of two front-running communities there, illustrating the potential for variety in local initiative, even within a centralized state. The cases of Gothenburg and Uppsala demonstrate not only the possibilities within the Swedish structure, but also, in their contrasting efforts and problems, the role of socio-organizational factors in the formation of technological decision making at the municipal level. The report concludes with a short summary of the major similarities and contrast and the implications of the Swedish experience for community energy policy in other settings.

## 2902 Economics And Sociology

*REFER ALSO TO CITATION(S) 36416, 36418, 36544, 36545, 36698, 36950, 36985, 37002, 37004, 37103, 37129*

36952 **(PB—87-173100/XAB) Four futures: energy implications of social and economic change.** Boshier, J.F.; Allan, R.R.; Ellis, M.J.; Gallacher, J.; Phillips, P.H. (New Zealand Energy Research and Development Committee, Auckland). Aug 1986. 82p. (NZERDC—135). NTIS, PC PC E04/MF E01.

The report provides an overview of the results and conclusions of a three-year project on long-term energy futures in New Zealand. The report discusses the background of the social, economic, and technological changes that have challenged old assumptions about the future. It then presents the outlines of the four scenarios developed in the project to explore the implications of these changes for the energy system. This is followed by a description of the energy system in each scenario. Comparisons are drawn for a wide range of topics. The research points to the need for resilience in the energy system in an uncertain future. The resilience of the energy systems in the four scenarios to a wide range of economic, social, technological, and environmental changes is assessed. Then strategies and tactics whereby the resilience of New Zealand's energy system might be enhanced are discussed. Major themes include the need to spread the risks, share the responsibilities and encourage competition through changes in ownership and administration in the energy sector.

36953 **(PB—87-182283/XAB) Documentation and user's manual for the Utility Cost Analysis Model. Final report.** Harrington, M.; Schauer, M.M. (Exeter Associates, Bethesda, MD (USA)). Feb 1987. 126p. NTIS, PC A07/MF A01.

The report serves as a user's manual and documentation for the Utility Cost-Analysis Model (UCAM), a computer model that calculates the lifetime revenues required by a utility making a discrete investment or series of investments. The model is written in FORTRAN and is designed to run on both a mainframe or an IBM PC, XT, AT, or compatible machine with a math micro-coprocessor chip. The model will perform a series of accounting calculations and determine the year-by-year revenues that the utility must receive from its ratepayers in order to achieve full cost recovery. In addition to the year-by-year revenues, lifetime revenues, and discounted present-value revenues are also calculated.

36954 **(PB—87-184370/XAB) Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation.** (New Zealand Energy Research and Development Committee, Auckland). Dec 1986. 53p. (NZERDC—137). NTIS, PC PC E04/MF E01.

This report states a number of operating assumptions in Section 2 and proceeds to examine the main elements of cost in providing additional gas reticulation in units of assumed small reticulation areas. Section 3 and the following section, which covers the likely avoidable costs or savings to the national electricity generation and distribution system, provide the basis for cost-benefit analysis in Section 5. Section 6 examines briefly some other possible benefits deriving from increased gas reticulation such as increased security of energy supply to connected consumers. An initial development of an approach to Phase Two demand studies is set out in Section 7, with reference to existing information on demand for gas and electricity in New Zealand.

36955 **(PB—87-185104/XAB) Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats.** (Department of the Treasury, Washington, DC (USA). Office of Tax Analysis). Jun 1986. 38p. NTIS, PC A03/MF A01.

The Recreational Boating Safety and Facilities Improvement Act of 1980 established a Recreational Boating Safety and Facilities Improvement Fund into which the Secretary of the Treasury was directed to pay excise-tax revenues attributable to fuels used in recreational motor boats. The Act also required the Secretary of the Treasury to carry out a study to determine the amount of such payment. The study concluded that, in 1985, 1.08% of gasoline excise-tax revenues could be attributed to this source. The study also developed a methodology that can provide estimates of motorboat fuel consumption that can be updated annually when new Coast Guard data become available. Using the methodology would ensure that gasoline excise-tax revenues attributable to motorboats capture the relative growth in motorboat use. It could also incorporate new State studies on the use of fuel by size of motorboat.

## 2903 Environment, Health, And Safety

*REFER ALSO TO CITATION(S) 36326, 36543, 36547, 36548, 36763, 36764, 36973, 37070, 37611, 37637, 37641, 37642, 37650, 37657, 37673, 37681, 37682, 37687, 37688, 37721, 37726, 37727, 37809, 37811, 37812, 37813, 37814, 37826, 37834, 37837, 37844, 37845, 37857, 37889, 37891, 37892, 37897, 37992, 38005*

36956 **(AD-A—179243/1/XAB) United States Coast Guard portable salvage computer. Final report.** Allen, S.J. (Coast Guard Research and Development Center, Groton, CT (USA)). Jul 1986. 137p. (CGR/DC—12/86). NTIS, PC A07/MF A01.

Document partially illegible.

The US Coast Guard's interest in marine salvage arises from its responsibility under the Federal Water Pollution Control Act and other laws dealing with oil spills. At vessel stranding situations, which could result in significant environmental damage through the release of oil or hazardous chemicals, the Coast Guard is represented by an On-Scene Coordinator (OSC), who must evaluate whether or not appropriate salvage techniques are applied to the stranded vessel by commercial salvors. To assist the OSC, who may not be trained in marine salvage, and other Coast Guard personnel assigned to such salvage operations, a portable salvage computer has been programmed to accomplish salvage calculations in a user-friendly manner. In this final report, the development of the salvage program and selection of a portable computer are described along with results of field testing with actual stranding situations.

**36957 (AD-A—179348/8/XAB) Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986.** Ng, E.K.; Tetla, R.A. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Mar 1987. 45p. (USAFOEHL—87-022EQ0156CHH). NTIS, PC A03/MF A01.

At the request of HQ AFSC/SGPB, the USAFOEHL conducted a hazardous-waste staff-assistance survey at Patrick AFB and Cape Canaveral AFS from 14 July 86 to 25 July 86. The scope of this survey was to address hazardous-waste minimization. The survey team performed a shop-by-shop evaluation of chemical-waste-management practices as well as met with hazardous-waste managers and engineers to discuss the hazardous waste program. The program was determined to be effective. Refinement of the program should include certification of the Air Force Management Laboratory for hazardous-waste analysis, documentation of waste-analysis procedures, expansion of analytical capability, reduction of the numbers of used-oil analysis, and operation of a solvent-recovery unit at Cape Canaveral AFS.

**36958 (BNL—52052) An environmental source book on the photovoltaics industry.** Moskowitz, P.C.; Kalb, P.D.; Lee, J.C.; Fthenakis, V.M. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012067.

Background information is given on the photovoltaic industry to assist in evaluation of future Premanufacture Notice submittals and the need for Significant New Use Regulations, implemented under authority granted by the Toxic Substances Control Act, for: an overview of the structure and nature of the past, present and future photovoltaics industry; steps involved in synthesizing and assembling photovoltaic cells, modules and arrays; chemicals used in these processes; potential chemical and physical hazards to workers in manufacturing facilities; potential hazards to public health and the environment from routine and accidental releases from manufacturing facilities; occupational and environmental control technology options; and applicability of current rules and regulations to potential chemical hazards in photovoltaic cell manufacturing facilities.

**36959 (DOE/HWP—25) DOE Hazardous Waste Remedial Actions Program: Annual report, FY 1986.** Eyman, L.D. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 189p. (ORNL/M—341). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011968.

The activities of HAZWRAP for the past fiscal year were organized into seven principal areas: technical analysis and technology transfer; regulatory analysis; strategic planning;information systems; program administration; technology adaptation; and technology demonstration. The scope, major FY 1986 accomplishments, and future directions for each of these areas are described in the following sections of this report. Listings of reports produced through the SCO are given in Appendixes A and B for the current year and since the program started, respectively.

**36960 (ES/ESH—2) Executive summary of long-range environmental management plans: FY 1987-1993.** Mitchell, M.E.; Jones, C.G.; Long, L.W.; Mezga, L.J.; Perry, T.P.A.; Stair, C.L. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Jun 1987. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011967.

The general strategy is to develop comprehensive, detailed environmental plans for the near-term (next one to three years), less detailed but probable plans for the mid-term (four to seven years), and general (tentative) plans for the long-term (greater than seven years). The costs associated with implementation of the plans are then presented separately for each of the first seven years and as a single estimated total for all years beyond the seventh year. While the long-term plans, and especially the long-term cost estimates must be viewed as very tentative, they do provide an important general understanding of probable needs, especially, for remedial actions where the long-term financial requirements are likely to be very significant. The Energy Systems Planning Activity is actually comprised of six separate sub-activities: Comprehensive Environmental Management (the administrative function); Air Pollution Control; Water Pollution Control; Solid Waste Management; Remedial Action; and Environmental Monitoring. Research and Development needed to implement each of these separate activities is included in each where appropriate. For each sub-activity, a set of objectives and strategies for meeting the objectives are formulated by a task team comprised of representatives from each installation. Each task team is under the oversight of a Central Environmental and Safety Activities Manager who also is responsible for obtaining understanding and agreement with DOE for his/her respective strategy. The remaining sections of this report provide (1) a summary of cost estimates for each of the next seven years, as well as for the long-term, and (2) a brief overview of the strategies to be followed in meeting the objectives for each of the six functional areas previously mentioned.

**36961 (NP—7752459) Publications on environmental policy in Japan.** (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 7p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752459.

IIUG publications on environmental policy in Japan, with particular regard to air pollution abatement measures, are listed. (HSCIi). With 37 refs.

**36962 (ORNL—6405) Environmental Regulatory Update Table, May 1987.** Brown, K.J.; Tucker, C.S.; Reed, R.M. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 91p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87011962.

Environmental Sciences Division Publication No. 2944.

Information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management oversight is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

**36963 (ORNL/ESH—1/V23) Resource Management Plan for the Oak Ridge Reservation: Volume 23, Oak Ridge National Environmental Research Park, Research Sites, and State Natural Areas.** Parr, P.D.; Pounds, L.R. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). May 1987. Contract AC05-84OR21400. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011973.

The Oak Ridge National Environmental Research Park (NERP) program provides 5008 ha (12,374 acres) of land and water areas on the Oak Ridge Reservation (ORR) that are protected for research and education in the environmental sciences. Through environmental research projects and other approved resource uses of the area, the NERP serves to demonstrate that energy technology and Department of Energy (DOE) facilities are compatible with a quality environment. Oak Ridge NERP activities include (1) research in the environmental sciences and coordination of all Environmental Sciences Division (ESD) research and monitoring sites on the NERP, (2) preservation of genetic diversity within the area and protection of sites for baseline information in research through NERP Natural Areas and NERP Reference Areas, (3) coordination with state and federal agencies regarding rare plant populations on the ORR and responsibility for the State Natural Areas registered on the ORR, (4) educational activities that allow precollege students to gain hands-on experience in environmental field activities, and (5) opportunities for college students and faculty to pursue research on the ORR. The original NERP Management Plan (1981), the DOE-NERP Charter, and its Program Directives are the basis for this volume. NERP activities and goals have been expanded and revised to reflect current directions. Also included are maps and descriptions of Research Sites, DOE-NERP Natural Areas and Reference Areas, and State natural Areas.

36964 **(PB—87-175345/XAB) Environmental Assessment Technical Assistance Handbook.** (Food and Drug Administration, Washington, DC (USA). Center for Food Safety and Applied Nutrition). Mar 1987. 380p. (FDA/CFSAN—87/30). NTIS, PC A17/MF A01.

The Environmental Assessment Technical Handbook has four types of Technical Assistance Documents (Sections 2.00-5.00) to assist persons preparing environmental information under 21 CFR Part 25, FDA's policies and procedures for implementing the National Environmental Policy Act. Section 2.00 describes how to assemble environmental information, determine if additional testing is needed, and prepare environmental documents to support petitions and applications for proposed actions. Section 3.00 describes methods used to predict the environmental fate of chemicals: water solubility; n-octanol/water partition coefficient vapor pressure; dissociation constant; ultraviolet-visible absorption spectrum; melting temperature; density and relative density; sorption/desorption; hydrolysis; photodegradation; and biodegradation. Section 4.00 describes methods used to predict the environmental effects of chemicals: algal growth; microbial growth inhibition; seed germination and root elongation; seedling growth; acute toxicity to Daphnia, Hyalella azteca, and freshwater fish; earthworm subacute toxicity; and Daphnia chronic toxicity. Section 5.00 describes procedures used to analyze effects test data. The FDA Center for Food Safety and Applied Nutrition and the FDA Center for Veterinary Medicine prepared the Handbook and will issue revisions or supplements as necessary to reflect comments received and advances in environmental assessment procedures and test methodology.

36965 **(PB—87-176541/XAB) EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Sep 1986. 88p. (EPA—600/9-86/028). NTIS, PC A05/MF A01.

See also report for FY-1985, PB—85-181881.

The free and open exchange of knowledge both stimulates and provides quality control for the progress of science. This report provides information on the research that EPA is planning, on how much EPA intends to spend on each program area, and on whom to contact for further details. More than 60% of the research budget will be spent through extramural contracts, grants, and cooperative agreements with organizations outside of EPA's laboratories. It is the intent of EPA to increase the efficiency and effectiveness of this research by placing great emphasis upon open competition for extramural support. It is hoped that the information in the report will stimulate qualified parties and make their capabilities known to research managers so that everyone might gain from sharing experience and expertise.

36966 **(PB—87-185500/XAB) Risk assessment, management, communication: a guide to selected sources. Information guide.** (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). Mar 1987. 208p. (EPAIMSD—87/002). NTIS, PC A10/MF A01.

The guide directs the reader to a wide spectrum of sources of information that address the basic and fundamental principles and issues of risk assessment, risk management, and risk communication. It is designed to assist EPA, other Federal, State and local governmental agencies, and the private sector in locating and building on existing knowledge of risk. It identifies experts and organizations within and outside EPA who are involved in the areas of risk assessment, management and communication. The guide also includes a section on other sources of information such as bibliographies, organizations, meetings and conferences, and course work that support risk research and education. The Appendices list EPA Regional risk coordinators, EPA libraries, and computerized databases that were searched in preparing this Guide. Subject areas excluded from this guide are hazardous waste, specific chemical risks and abatement technology.

36967 **(PB—87-185583/XAB) Bibliography on chemical emergency preparedness and prevention.** (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). Dec 1986. 331p. (EPA/IMSD—86/005). NTIS, PC A15/MF A01.

The bibliography contains information on the effects of accidental releases of acutely toxic chemicals. It includes references to articles on hazard identification, prevention of chemical accidents, mitigation of chemical releases, environmental ramifications of chemical hazards, access to chemical toxicity and exposure information, conferences on the topic and international aspects of chemical accidents. The bibliography is part of EPA's program to increase community awareness of chemical hazards and to develop state and local emergency-response plans.

36968 **(PB—87-904200/XAB) EPA (Environmental Protection Agency) Publications Bibliography. Quarterly abstract bulletin. Quarterly report.** (Environmental Protection Agency, Washington, DC (USA). Office of Administration). 1987. vp. NTISSubscription.

Supersedes PB—86-904200; Paper copy available on subscription, North American Continent price $80.00/year; all others write for quote. Single copies also available in paper or microfiche.

EPA Publications Bibliography is a quarterly abstract bulletin containing the abstracts, corporate source, subject, contract number, and title indexes. The fourth issue of the year contains bibliographic citations with abstracts for the proceeding quarter and cumulative indexes for the calendar year.

## 2904 Natural Resources

*REFER ALSO TO CITATION(S) 37620, 37688, 37757, 37851, 37896*

36969 **(PB—87-183158/XAB) Assessment of selected legal/institutional constraints to water conservation in the western states.** Glickstein, R.J.; Heimbichner, R.; Rosenbaum, S.; Downing, D. (Teknekron Research, Inc., Berkeley, CA (USA)). Apr 1981. 369p. NTIS, PC A16/MF A01.

A study was made of four legal/institutional constraints to water conservation in the agricultural sector of the seventeen western states. The objectives of the study were to: identify major perceived legal/institutional constraints to water conservation in the western states and summarize what has been reported in the literature regarding each; determine how these perceived obstacles operate in each of the western states (through an investigation of statutes, judicial decisions, and administrative procedures); determine the extent to which each perceived obstacle represents an actual constraint to efficient water use; and offer a set of recommendations aimed at mitigating the actual legal/institutional constraints, if any, in the western states.

36970 **(PB—87-184859/XAB) Estimates of wastewater-treatment capital requirements in rural America. Staff report.** Ryan, B. (Economic Research Service, Washington, DC (USA). Agriculture and Rural Economics Div.). Apr 1987. 38p. (AGES—861218). NTIS, PC A03/MF A01.

The study examines the changes in capital requirements needed to bring rural wastewater-treatment systems into compliance with Clean Water Act standards. Results indicate a significant but concentrated reduction in backlog costs and dramatic increase in service availability between 1978 and 1984. System needs are estimated at $20.2 billion, with residents in the Northeast and in the smallest rural communities facing the highest per-capita costs.

## 2905 Research, Development, Demonstration, And Commercialization

*REFER ALSO TO CITATION(S) 36305, 36698, 37012, 37055, 37475*

36971 **(DOE/MA—0297-1) Quarterly status of Department of Energy Projects.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). 31 Mar 1987. 477p. NTIS MF A01; 2; GPO Dep. File Number DE87012000.

Cost and schedule information for all projects in the design or construction phase are listed as of March 31, 1987. The first section in the package is a Summary Report which functions as an index to the detailed Project Report. The numbers in the last

column correspond to the page numbers of the projects in the Project Report. The Summary Report is followed by a series of variance reports including a Total Estimated Cost (TEC) Report, a Total Project Cost (TPC) Report, and a Schedule Construction or Fabrication Complete Variance report. The final section is a detailed Project report which addresses each individual project.

36972 **(DOE/S—0058) Review of the National Research Council report: Physics through the 1990's.** (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). Feb 1987. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87008149.

The report of the National Research Council (NRC), Physics through the 1990s, highlights past developments and research opportunities in the various subfields of physics and addresses general issues concerning the present state of the discipline in the United States. At the request of the Secretary of Energy, the Energy Research Advisory Board (ERAB) reviewed this report and identified the areas that relate to the programs and objectives of the Department of Energy (DOE). The present report provides the conclusions of this review and the recommendations for the Department's actions.

36973 **(PB—87-177812/XAB) Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment).** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jan 1987. 142p. (OTA-A—327). NTIS, PC A07/MF A01.

See also PB—86-120425, and PB—87-177804.

The Office of Technology Assessment (OTA) was established by the Technology Assessment Act of 1972 (Public Law 92-484) to provide the Congress with the new effective means for securing competant, unbiased information concerning the physical, biological, economic, social, and political effects of technological applications. The report summarizes the activities of OTA for the calendar year 1986. Included are discussions of its organization and operation, summaries of assessments completed during 1986, descriptions of work in progress, and a list of staff members, advisors, and panel members. A copy of the Technology Assessment Act of 1972 is also included.

36974 **(PB—87-177846/XAB) Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment).** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jan 1985. 126p. (OTA-A—275). NTIS, PC A07/MF A01.

See also Annual report for 1983, PB—84-173814.

The report summarizes the activities of the Office of Technology Assessment (OTA) for the calendar year 1984. Included are discussions of its organization and operation; summaries of assessments completed during 1984; descriptions of work in progress; a list of staff members, advisors, and panel members. A copy of the Technology Assessment Act of 1972 is also included.

## 2906 Nuclear Energy

*REFER ALSO TO CITATION(S) 36495, 36496, 36543, 36544, 36545, 36547, 36548, 36550, 36558, 36790, 36791, 36792, 36793, 37000*

36975 **(EGG-M—00387) The future of nuclear power.** Zeile, H.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-870173—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009345.

From Pikes Peak section of IEEE; Colorado Springs, CO, USA (22 Jan 1987).

Present conditions and future prospects for the nuclear power industry in the United States are discussed. The presentation includes a review of trends in electrical production, the safety of coal as compared to nuclear generating plants, the dangers of radiation, the economics of nuclear power, the high cost of nuclear power in the United States, and the public fear of nuclear power. 20 refs. (DWL)

36976 **(NUREG—0940-Vol.5-No.4) Enforcement actions: Significant actions resolved: Quarterly progress report, October-December 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Feb 1987. 578p. NTIS, PC A25 - GPO. File Number DE87900540.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (October-December 1986) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions and the licensees' responses. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, in the interest of promoting public health and safety as well as common defense and security.

## 2910 Conservation

*REFER ALSO TO CITATION(S) 36950, 37001, 37046, 37057, 37099, 37102, 37129*

## 2920 Supply, Demand, And Forecasting

*REFER ALSO TO CITATION(S) 36952, 36955, 36984, 36991, 37004*

36977 **(DOE/EIA—0035(87/03)) Monthly energy review, March 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 30 Jun 1987. 137p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE87011892.

Although crude oil prices were noticeably higher in the first quarter of 1987 - the composite refiner acquisition cost of crude oil averaged almost $17 per barrel, up from the 1986 average of $14.55 per barrel - the domestic energy industry continued to feel the effects of the disruptions of 1986. US energy production in the first quarter of 1987 (Q187) was 16.1 quadrillion Btu, 3.6% below the level in the first quarter of 1986. Energy consumption totaled 19.9 quadrillion Btu (down 1.5%) and a 26.2% increase in net imports was required to meet demand. However, the 2.6 quadrillion Btu of energy net imports in Q187 was well below the all-time high for first quarter net imports (4.9 quadrillion Btu) reached in 1977. Petroleum production continued to show the effects of the 1986 decline in oil prices; it fell to 4.9 quadrillion Btu in Q187, a decline of 7.5% from the Q186 level. Although Alaskan production increased slightly, production in the lower 48 States and production of natural gas plant liquids declined. Natural gas production fell 0.8% to 4.4 quadrillion Btu. Production of coal, which faced increased competition from petroleum products, fell 5.7% to 4.7 quadrillion Btu. Nuclear-based electricity generation reached an all-time high in Q187, and oil-fired electricity generation increased for the second consecutive year, after having registered decreases for the previous 7 years. In contrast, coal-fired generation declined, due primarily to increased competition from cheaply priced heavy oil. However, coal-fired generation of electricity continued to account for over half of total generation from all sources.

36978 **(FRNC-TH—1996) Development possibilities of solid mineral fuels in the energy balance of Morocco.** Abderrahmani Ghorfi M. (Dijon Univ., 21 (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Jan 1984. 270p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE87752319.

Energy consumption is low in Morocco but rapidly growing, unevenly distributed and based on imported oil. The contribution of solid mineral fuels: coal, oil shales and uranium is analyzed, using domestic resources or for the diversification of energy supplies. Use of coal for electricity production, in the cement industry is examined. To reduce energy dependence up to the year 2000, energy conservation, exploration, new energies and development of domestic oil shales and uranium from phosphates are reviewed.

**36979** **Energy statistics and the planning perspective.** Hutber, F.W. *Statistician;* **33**: No. 1, 1-7(Mar 1984). (CONF-830743—).

From Conference on energy statistics; Cambridge, UK (6 Jul 1983).

The authors contend that given a reasonable understanding of the energy system and statistical competence, anyone can produce an energy forecast. But whether that forecast is meaningful and acceptable will depend largely on the quality of the assumptions made in producing it. Usually, and perhaps unfortunately, the assumptions are not completely in the hands of the analyst. The decision-maker and perhaps some external parties will exert influence in deciding the assumptions to be used and must therefore carry a major responsibility for the quality of the forecasts.

## 2930 Policy, Legislation, And Regulation

*REFER ALSO TO CITATION(S) 36495, 36496, 36543, 36886, 36962, 36991*

**36980** **(ENEA-RT/STUDI—85-3) Feasibility study about a National Integrated Informative System in the energy field. Results of a research on the national real demand of energetic information.** Mazza, M.; Sano', A.; Vaccaro, R. (ENEA, Rome (Italy)). Apr 1986. 86p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752625.

Within the second Energetic Development Project (PFE2) a feasibility study about a National Integrated Informative System in the energy field has been begun. This initiative should consent to confront the present numerous problems in the national statistical information; its aim is the project of the above the integrated system. The first step of the feasibility study in 1984 has consisted in a research through questionary, to characterize the national real demand of energetic information. The results of this research, which regards 586 operators, have shown high interest in energetic information; it has different peculiarities according to the classes of the interviewed firms. The traditional energy sources have a considerable weight, especially in the economic aspects. The variables "consumption" and "prices" are the first ones to be analyzed in the study of the informative system.

**36981** (STEV—1986-3, pp 13-26) **Background paper: Soviet energy policy.** Dellenbrant, J.-Aa. (Uppsala Univ. Sweden. Dept. of Soviet and East European Studies). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

In this paper, some fundamental elements of the Soviet energy policy are analyzed. The specific areas included in the paper are, among others, the physical conditions of Soviet energy policy, the role of energy in the Soviet policy toward the Comecon countries and toward the Western markets. Also, the role of energy in Soviet foreign policy will be commented upon as well as the problem of dependence on Soviet energy from the West's point of view. The main focus of the paper is on the Soviet Union although some comparisons will be made with the European Comecon countries, i. e. the GDR, Poland, the Cssr, Hungary, Romania and Bulgaria. Furthermore, the main focus will be on problems concerning energy production from fossile fuel and hydrocarbons, but water power and nuclear power will also be considered. The paper is devoted to the policy aspects of Soviet energy, rather than to technical problems.

**36982** (STEV—1986-3, pp 27-41) **Energy policy in the USSR.** Goldman, M.I. (Harvard Univ., Cambridge, MA. USA. Russian Research Center). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

To the extent that Gorbachev is sincere and determined to change the way Soviet managers waste the Soviet Union's resources, he will not have an easy task. As distressing as it may be, the failure to evolve another policy does not necessarily foretell any inevitable crisis for the Soviet economy. Those who are sensitive to the fact that energy raw materials are not renewable resources will continue to be distressed by the waste around them and the knowledge of the opportunities being lost. However, the enormous size of the Soviet Union means that there most likely are as yet undiscovered deposits just over the horizon. Obviously such optimism cannot last forever, but for the near future the Soviet Union will continue to have more energy resources at its disposal than almost all of the world's industrial producers.

**36983** (STEV—1986-3, pp 75-91) **Energy situation and politics in the USSR.** Hewett, A. (Brookings Institution, Washington, DC USA). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

The soviet energy situation is both the best and the worst it has been in the last quarter century. It is the best by measures of the energy balance itself: production is the highest it has ever been, and continues to grow; net exports are likewise at an all-time high; and hydrocarbons move about the USSR primarily through a huge and complex pipline transmission system. Proved energy reserves are enormous and further exploration will surely prove up significant new reserves. On the other hand, the problems with this industry are formidable. The bulk of the reserves is in sparsely populated regions, far from industrial centers and export markets, and in extraordinary harsh climates. Consequently as energy production shifts eastward the total investment resources required to even sustain, let alone increase, energy output are growing much more rapidly than investment in the total economy.

## 2940 Fossil Fuels

*REFER ALSO TO CITATION(S) 36235, 36305, 36326, 36365, 36381, 36416, 36417, 36418, 36427, 36437, 36954*

**36984** **(DOE/EIA—M021) Documentation of the resource allocation and mine costing (RAMC) model: Methodology description.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). May 1987. 182p. NTIS, PC A09/MF A01 - GPO; 1; GPO Dep. File Number DE87011188.

The RAMC produces the quantity-price relationships in coal supply for 30 coal types (further distinguished between surface and deep mines) and 32 producing regions based on the 1984 EIA Demonstrated Reserve Base, engineering estimates of mining costs for various surface and underground mines, and region-specific and coal-type-specific cost elements. This model serves as a major component of the Intermediate Future Forecasting System, the National Coal Model, the International Coal Trade Model, and the Coal Supply and Transportation Model.

**36985** **(NP—7770110) Economic development under the influence of oil exports: The Nigerian example.** Attipoe, J. (Goettingen Univ. (Germany, F.R.). Fachbereich Wirtschaftswissenschaften). 5 Feb 1985. 207p. NTIS (US Sales Only), PC A10/MF A01. File Number DE87770110.

This dissertation adopts an analytical approach, which is backed first, by theoretical models, and second, by empirical analysis. Two different theoretical models are employed at two different stages of the analysis. At the initial stage, a two-gap model is introduced and applied to the Nigerian economy. The conclusion arrived at necessitates the second model analysis, based on the 'Dutch disease' concept. The work is arranged in four chapters. Chapter 1 covers the introductory part, comprising the historical background, and the method of approach. Chapter 2 opens with a discussion on the criteria for economic development. In chapter 3 the problems of capital formation in a surplus-savings economy (Nigeria) are examined. Finally, in chapter 4 relevant policy conclusions are considered and appropriate measures recommended.

**36986** **(PB—87-928600/XAB) International Energy Statistical Review. Monthly report.** (Central Intelligence Agency, Washington, DC (USA)). 1987. vp. NTISSubscription.

Supersedes PB—86-928600; Paper copy available on subscription, North American Continent price $55.00/year; all others write for quote. Also available in single copies.

The International Energy Statistical Review provides current information and comparisons with recent years for a variety of topics on international energy; almost all concern some aspect of the petroleum and natural gas industries. Six charts deal respectively with total Free World oil production, OAPEC oil production, non-Arab oil production, Free World and USSR oil production, inland oil consumption, and net oil imports. In general, the time period covers the last four or five years. The remainder of the Review is made up of 31 tables, covering such disparate topics as production, capacity, reserves, trade, consumption and stocks. Areas covered include the world, Free World, OPEC, OAPEC, OECD, selected developed countries, Western Europe, China, USSR, and Eastern Europe.

36987 **(STEV—1986-3) Soviet energy. Proceedings from an international seminar.** (Statens Energiverk, Stockholm (Sweden)). 1986. 94p. (CONF-8506356—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397.

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

This study focuses on the Soviet Union's role as one of the leading energy producers. This is an area where we have relatively limited knowledge. Therefore, the National Energy Administration arranged a two-day international seminar in June 1985. Several internationally-prominent experts on the Soviet Union's energy situation participated in this seminar. More than 25 participant representing six countries attended. The principal speakers were Marshall I. Goldman, Michael Kaser, Jonathan Stern and Ed A. Hewett. This study contains chapter on: - Energy policy in the USSR - Energy trade within Comecon - The USSR on the world markets - Energy and politics.

36988 (STEV—1986-3, pp 7-12) **Conclusions from the seminar.** Tham, C. (Swedish International Development Authority, Stockholm, Sweden). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

In summary, this seminar confirms that the Soviet Union is a trade partner to be counted on in the future as well. Oil will most probably continue to be the most important Soviet export for the remainder of this century and cannot be replaced by natural gas. Future Soviet energy policy decision will be based on a careful balance between investments and consumption and between different important investment areas. The most important investments can be made within the areas of oil substitution and conservation. True success in these areas, however, will probably require considerable economic reforms of a type which may not be possible. Soviet foreign policy is not appreciably affected by energy issues and vice versa. This does not apply, however, to the relationship with the Eastern European countries.

36989 (STEV—1986-3, pp 42-61) **Energy trade within Comecon.** Kaser, M. (St. Antony's College, Oxford, Great Britain). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

A review is presented of energy production, consumption and trade in the comecon countries. Principles of energy trade pricing between the comecon countries are discussed.

36990 (STEV—1986-3, pp 62-74) **Soviet energy exports to world markets.** Stern, J.P. (Royal Institute of International Affairs, London, Great Britain). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752397. (CONF-8506356—).

From International seminar on Soviet energy; Soderfors, Sweden (6 Jun 1985).

Soviet exports to the hard currency area (but not necessarily to 'world markets' will fall from more than 100 million tons of oil equivalent (mtoe) in the mid 1980s, to around 75 mtoe by the the end of the century. Soviet energy exports to the hard currency area will also fall, perhaps by as much as 40 per cent over the next 10-15 years. The reason for the greater fall in revenues is the increasing preponderance of gas which sells for less than oil on a btu basis. Some of these gas exports will be traded on a barter basis.

36991 **A statistical analysis of the UK steam boiler stock.** Chesshire, J. (Science Policy Research Unit, Univ. of Sussex, Falmer, Brighton BN1 9RF). *Statistician;* 33: No. 1, 143-150(Mar 1984). (CONF-830743—).

From Conference on energy statistics; Cambridge, UK (6 Jul 1983).

This paper summarizes work undertaken at SPRU on a study aimed at identifying the key characteristics of energy use for steam raising in the industrial and commercial sectors of the UK. Steam raising accounts for nearly one-half of UK primary energy demand and for some two-thirds of fossil fuel demand in industry and commerce - yet this has not been the subject of such detailed analysis before. The paper falls into three parts. The first explains the intellectual and energy policy justifications for work on energy-using capital stocks. The second briefly examines the methodology employed in assembling a data base covering some 30,000 steam boilers, primarily using insurance industry sources. The third outlines a novel way in which disaggregated capital stock data can be utilized in forecasting exercises - in this case to cast light on the market prospects of the fossil fuels, especially coal, in the large and competitive industrial crude heat market.

## 2950 Hydrogen And Synthetic Fuels

*REFER ALSO TO CITATION(S) 36235*

36992 **(ENEA-RT/FARE—86-7) Ethanol production from agricultural raw materials.** Di Giorgio, G. (ENEA, Rome (Italy)). Sep 1986. 72p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752626.

The Community Directives concerning the possible introduction of oxygenated organic compounds in gasoline as substitutes for alkyl lead has opened new market sectors, creating competition between products derived from oil and products from renewable raw materials of agricultural source, mainly ethanol. The ethanol production from agricultural raw materials (bioethanol) is actually feasible in the European Community - in quantitative terms - only from cereal surpluses, andpartially from sugar beet surpluses. However, it has been estimated that the operation "bioethanol" from agricultural surpluses is in itself uneconomic. The adoption by the European Community of a flexible programme for bioethanol production, not only limited to considering as raw materials the agricultural surpluses, but also other solutions such as new crops for alcohol production or lignocellulosic materials, could allow Italy the choice of a strategy which is more consistent with the particular national situation. The introduction of innovative technologies could give a positive contribution to the general economy of the bioethanol production processes.

## 2960 Electric Power

*REFER ALSO TO CITATION(S) 36365, 36763, 36764, 36953, 36954*

36993 **(CONF-8703148—1) The death spiral: An assessment of its likelihood in electric utilities.** Hemphill, R.C.; Costello, K.W. (Argonne National Lab., IL (USA); Costello (Kenneth W.), Springfield, IL (USA)). 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011511.

From 51. annual meeting of the Midwest Economics Association; St. Louis, MO, USA (26 Mar 1987).

First, we present the death spiral hypothesis (high rate increases leading to bankruptcy), providing a historical background on its inception and discussing the observations provided in other industries of its occurrence through the years. Then we provide a discussion of the conditions necessary for the spiral effect. In doing this we provide insight into the assumptions implied by those who forecast such doom. Based on this discussion, we then provide the reader with a discussion of the implications such a concept has for

regulatory policy. In addition, we conclude that given the structure of the regulatory process, the chances of a spiral effect for the electric utility industry have probably been overstated. It is shown that the occurrence of a death spiral is based on unrealistic conditions about the response of a utility's customers to higher rates, the incentives of and constraints facing regulators regarding pricing and permitting a utility to experience permanent financial distress, and the intense actions of a utility's management to avoid financial disaster.

36994 **(DOE/BP—707) 1986 variable industrial power rate: Executive summary of Administrator's Record of Decision.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1986. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010345.

The Administrator's Record of Decision (ROD) is the official document presenting the decisions and rationales used by the Administrator of the Bonneville Power Administration (BPA) in the development of BPA's 1986 Variable Industrial Power (VI-86) rate. The Administrator's decisions are based on written and oral testimony and exhibits admitted into the record as evidence during the rate case proceedings held pursuant to section 7(i) of the Pacific Northwest Electric Power Planning and Conservation Act (Pacific Northwest Power Act). BPA has submitted the proposed rate to the Federal Energy Regulatory Commission (FERC) for final confirmation and approval. BPA also requested and was granted interim approval from the FERC to implement the proposed rate on August 1, 1986. 1 tab.

36995 **(EPRI-EM—5175) Proceedings: 1986 Electric Utility Market Research symposium.** Limaye, S. (Synergic Resources Corp., Bala-Cynwyd, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 603p. (CONF-8611166—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920480.

From Electric utility market research symposium; Kansas City, MO, USA (5 Nov 1986).

This report contains the papers presented at the Electric Utility Market Research Symposium held November 5-7, 1986 in Kansas City, Missouri. Cosponsored by the Electric Power Research Institute and the Electric Utility Market Research Council, the purpose of the symposium was to provide a forum for the review and exchange of information on market research techniques and their applications throughout the electric utility industry. The papers contained herein were presented by utility and industry professionals and highlight the major issues related to market research. The two and one-half day symposium featured formal presentations from a number of market research specialists on such topics as: the need for and value of market research, customer preference and behavior, evaluation of market research programs, and advertising and communication effectiveness. During the second day of the symposium, workshops were conducted on attitudes and image measurement, customer segmentation, test marketing, and conjoint analysis. A panel discussion on the final morning explored integrating market research into the utility mainstream and focused on current programs and future directions for market research in the utility industry. 36 refs., 26 figs., 18 tabs.

36996 **(EPRI-EM—5226) Competition: Pressures for change: Final report.** Morman, L.M.; Emanuelson, N.; Horgan, D. (Price Waterhouse, Pittsburgh, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 80p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920453.

This study was undertaken to determine the major forces of competition facing the electric utility industry and to investigate how the Electric Power Research Institute can assist the industry in making the transition to a more competitive environment. The study methodology included a survey of literature on competition, interviews with electric utility industry executives and interviews with executives from other industries. The study revealed two basic types of competitive strategies available to electric utilities - become the lowest-cost producer or focus on high levels of customer service and support. If electric utilities are to be successful in the future, the industry must identify and address key issues today. Six categories of research were identified: technology modernization, competitive analysis, targeting, productivity, measurement and control, and new business opportunities. 36 refs.

36997 **(EPRI-P—5160-SR) Ninth EPRI Member Utility Survey results.** Feher, J.S. (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 122p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920506.

The results of the Ninth EPRI Member Utility Survey are presented in this report with limited interpretation and discussion. The survey is used by EPRI to obtain information from the utility industry as input to its strategic plan. This survey sought to obtain insight into the industry's perception of its own future, to rank EPRI's criteria for evaluating research and EPRI's strategic programs. 28 tabs.

36998 **(NEI-DK—26) Switching-off power loads in industry.** Johansson, M. (Dansk Kedelforening Energi and Miljoe, Soborg). Nov 1984. 69p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752371.

The prospects of switch-off loads in industry are described. A price reduction of 2 oere/kWh for switching-off is assumed. If the load is reduced by 3 hours daily during a year the total load will be about 140-210 MW. Production lost by switching-off can be recovered in other periods. Warning time for switch-off is varying (for instance for refrigeration and melting furnaces) for different types of industrial companies. (EG).

36999 **(PB—87-171989/XAB) Power plant report, monthly cumulative for 1987 (EIA-759). Data file.** Johnson, M.; Colligan, J. (National Energy Information Center, Washington, DC (USA)). 1987. mag tap. NTIS CP T02.

Supersedes PB—86-178035; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The purpose of Form EIA-759, formerly FPC-4, Power Plant Report is to collect data necessary to fulfill regulatory responsibility; ensure power reliability; and measure fuel consumption and power production. The data tape contains the data collected by the survey and include: specific ownership code, prime-mover code, kind of fuel code, company code, plant name, current capacity, fuel name, old capacity, effective date - month/year, status, multistate code, current year, generation, consumption, stocks, electric plant code, and NERC code.

37000 **(PB—87-173381/XAB) Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987.** (Interagency Advanced Power Group, Fort Belvoir, VA (USA)). Mar 1987. 74p. NTIS, PC A04/MF A01.

See also PB—85-102861.

The Semiannual Compilation of Project Briefs represents a complete listing of the projects maintained in the automated PIC database. The information is presented in three separate categories. Part I of the volume is a listing, by field of interest, of all active IAPG project briefs registered with PIC as of January 1987. The fields of interest include chemical, electrical, magnetohydrodynamics, mechanical, nuclear, solar, and systems energy research. The listing gives the brief number, the title of the project, the project manager, the directing agency, the research facility, and funding information, where available. The key to the codes for the directing agencies follows the introduction. Part II of the publication is a listing of project briefs by index term. The list includes project briefs still active as of January 1987. Part III of the publication is a compilation of project briefs which were cancelled or completed during 1986. The listing of completed and cancelled briefs is published annually in every February Issue of the Semiannual Compilation.

37001 **Effect of conservation programmes on electric utility earnings: results of two case studies.** Kahn, E.; Pignone, C.; Eto, J.; McMahon, J.; Levine, M. (Lawrence Berkeley Lab., CA, USA). *Energy Policy;* **15**: No. 3, 249-261(Jun 1987).

This paper develops methods to measure the impact of conservation programmes on electric utility earnings. The methods are applied to two case studies. Detroit Edison represents a case where impacts are unfavourable. This utility has 'excess capacity' which is only made worse by conservation. Pacific Gas and Electric represents a case where conservation helps defer the need for new capacity. Even in this case, programmes targeted at summer peak demand are more beneficial than those which save baseload energy. Conditions determining the earnings impact of conservation are complex, involving regulatory factors that are specific to individual utilities.

### 2980 Consumption And Utilization

37002 **(DOE/EIA—0482) Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Jun 1987. 252p. NTIS, PC A12/MF A01 - GPO; 1; GPO Dep. File Number DE87011891.

The data are by Census region and by four major energy sources: electricity, natural gas, fuel oil/kerosene, and liquefied petroleum gas (LPG). Methodology is described. The major findings are energy consumption per household for the Nation has declined from 137.9 (+-5.8) million Btu in 1978 to 104.7 (+-3.0) in 1984; an overall decline of 33.2 (+-6.5) million Btu. The largest declines in consumption for the average household across the nation occurred from 1978 to 1979, 1979 to 1980, and 1981 to 1982. These declines were all statistically significant at the 95-percent confidence level, while changes for the other time intervals were not statistically significant. Average consumption for each fuel declined, though the decline for average electricity consumption was barely significant. Among the four major fuels considered, electricity increased its share of average consumption per household, while the share for fuel oil/kerosene declined. The shares for natural gas and for LPG did not change significantly. Among the four Census regions, the largest drop in average consumption per household occurred in the North Central and Northeast regions. Price increases more than offset the declines in consumption, giving a statistically significant increase in expenditures per household for all fuels from $724 in 1978 to $1,123 in 1984 for the Nation. For most fuels, average expenditures per household generally increased each year. The major exception was fuel oil/kerosene for which expenditures peaked near 1980 (the precise year varied with the Census region) and then declined.

### 2990 Unconventional Sources And Power Generation

*REFER ALSO TO CITATION(S) 36633, 36638, 36698, 36958*

37003 **(PB—87-174058/XAB) Alternative energy sources guidebook. Final report.** Baxter, W.D. (Maryland Energy Administration, Annapolis (USA)). Mar 1987. 735p. NTIS, PC A99/MF E04.

The publication is offered as an informational guide - a primer - for Marylanders interested in obtaining a basic understanding of Alternative Energy Generation Technologies potentially available in the state. An attempt is made to assess the technical and economic feasibility and environmental impacts of each technology. The Guidebook expands upon the Renewable Resources section of the Maryland Energy Administration's Energy in Maryland report, to be published in January of 1987, and the Power Plant Cumulative Environmental Impact Report, published in January of 1986. The sources and technologies addressed in the Guidebook include alcohol fuels, ground water heat pumps, municipal solid waste, small-scale hydropower, solar, wind, and residential and industrial wood.

37004 **Contribution of renewable energy technologies to future energy requirements.** Buckley-Golder, D.H.; Derwent, R.G.; Langley, K.F.; Walker, J.F.; Ward, A.V. (Energy Tech. Div., AERE Harwell, Oxfordshire). *Statistician;* 33: No. 1, 111-132(Mar 1984). (CONF-830743—).

From Conference on energy statistics; Cambridge, UK (6 Jul 1983).

It has been recognized for some years now that there could be a significant contribution from renewable energy technologies to future energy supplies. The actual contribution which these technologies can be realistically expected to make in the UK is identified in the light of the Department of Energy's R & D programmes. This paper considers not only the economic prospects for the renewable energy technologies, but also the institutional, environmental and market-related factors which are likely to affect their exploitation in the UK.

## 30 DIRECT ENERGY CONVERSION

### 3001 Mhd Generators

37005 **(CONF-870664—2) Particle evolution in MHD systems.** Wang, C.S.; Lindner, J.S. (Argonne National Lab., IL (USA); Mississippi State Univ., Mississippi State (USA). MHD Energy Center). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87011447.

From 25. symposium on engineering aspects of magnetohydrodynamics; Bethesda, MD, USA (24 Jun 1987).

In MHD power plants, significant amounts of seed and slag particles are present in the combustion gas. The existence of these particles will significantly affect the performance of MHD components. Therefore, it is essential to be able to measure or predict the spectrum of the particle size and number density. A series of experimental tests has been conducted to measure the particle sizes and number densities of seed particles by using two-color laser transmissometry. The measured values have been compared with the predictions from the theoretical model, and a reasonable qualitative agreement has been obtained between the measurement and theory. The present work has demonstrated our ability to measure and predict particle evolution in MHD environments. 30 refs., 6 figs., 2 tabs.

37006 **A centralized MHD data base.** Peters, W.C.; Ruppel, T.C.; Hirschenhofer, J.H. (Pittsburgh Energy Technology Center, Pittsburgh, PA). pp 115-122 of Technical economics, synfuels and coal energy - 1987. Dicks, J.B. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

A tool that should be of interest and use to many in the energy technology fields is being developed in the magnetohydrodynamic (MHD) community. This tool is a centralized data base of MHD technical information. The major objectives of this data base are to do the following: transfer existing information to support new endeavors in the MHD technology area as well as in energy technology areas having similar environments (high temperature, etc.); be a recognized central repository for information generated in the MHD program; to avoid loss of information and to assist in avoiding duplication of effort; and be concise, be readily available, contain the latest MHD information and data, and be user responsive.

### 3003 Thermoelectric Generators

37007 **(AD-A—179353/8/XAB) Thermoelectric conversion with ion conductors. Quarterly technical progress report No. 2, 1 November 1986-15 January 1987.** (Bipel International, Inc., Trumbull, CT (USA)). 15 Jan 1987. 12p. NTIS, PC A02/MF A01.

This report highlights progress accomplished during the second quarter: Electrolyte conductivity versus composition studies are continuing on both zirconia and bismuth oxide compounds. Electrode studies were initiated to find an efficient electrode to operate at high temperatures (i.e. 1000 C) for the high-temperature side of the heat engine. A bi-element thermoelectric cell was constructed and tested to identify the critical design considerations for efficient energy conversion.

37008 **(SAND—87-1306C) Progress toward a mercury heat engine: Synthesis of a mercury electrolyte.** Hammetter, W.F.; Farrington, G.C.; Hellstrom, E.E. (Sandia National Labs., Albuquerque, NM (USA); Pennsylvania Univ., Philadelphia (USA); Wisconsin Univ., Madison (USA)). Jun 1987. Contract AC04-76DP00789. 16p. (CONF-870804—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010034.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Liqud metal thermal-electric converters (LMTEC's) are being evaluated for terrestrial solar energy conversion applications. It has been determined that to meet current energy cost goals, an efficiency greater than that presently obtainable from Na-LMTEC's is required. One way to increase efficiency is to use Hg as the working fluid. Calculations have shown that the projected efficiency of a Hg-LMTEC solar system is approximately 25% as compared to about 16% for a Na-LMTEC system. The increased efficiency arises from a lower working temperature range (400-600 C vs 800-1000 C) and higher pressure over the liquid metal (several tens of atmosphere vs. about 1 atmosphere). A major technological barrier which must be surmounted is that a suitable Hg(II) conducting electrolyte does not exist. Successful development of a mercury heat engine requires the development of a suitable Hg electrolyte. This paper decribes the necessary properties of such an electrolyte, and our efforts to attain it. We describe ion-exchange experiments on single crystals of Na(I) beta″ - alumina and report some important properties on partially exchanged crystals. Thus far we have replaced approximately 60% of the monovalent ions in the starting crystals after about 300 hours in the exchange media. Electrical properties of the partially exchanged crystals are like that of other divalent beta″ - aluminas and the crystals are stable to about 600 C. 8 refs., 4 figs.

## 3005 Fuel Cells

37009 **(CONF-870172—3) High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells.** Sawicka, B.D.; Ellingson, W.A.; McPheeters, C. (Argonne National Lab., IL (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1987. Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011479.

From 11. annual conference on composites; Cocoa Beach, FL, USA (18 Jan 1987).

Advanced monolithic solid oxide fuel cells are being assembled from thin (~50 μm) tape-cast ceramic layers with highly tailored mechanical properties. The layers need to be free of cracks and nonbonds. A high-resolution computed tomography system with a $^{192}$Ir source was investigated as a tool for detecting cracks and nonbonds. Results suggest that channel sizes, including internal channels, can be dimensional but that small in-plane cracks cannot be detected.

37010 **(CONF-870804—16) Monolithic fuel cells.** Fee, D.C.; Billone, M.C.; Busch, D.E.; Dees, D.W.; Dusek, J.; Easler, T.E.; Ellingson, W.A.; Flandermeyer, B.K.; Fousek, R.J.; Heiberger, J.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011383.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A new fuel cell design, called the "monolithic fuel cell," is being developed at Argonne National Laboratory. The monolithic design employs the same thin ceramic components used in other oxide fuel cells in a strong, lightweight honeycomb structure of small cells, and thus can achieve very high power per unit mass or volume. The light weight and low volume, as well as the efficiency and reliability of electrical systems, are advantageous is space systems. Considerable progress has been made in developing monolithic fuel cells. Small arrays (stacks) of monolithic fuel cells having prototypical dimensions have been fabricated and operated.

37011 **(DOE/MC/19403—1816) Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants: Final report for the period October 1982-January 1985.** Anderson, G.L.; Berry, F.O.; Harmon, B.D.; Laurens, R.M.; Biljetina, R. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1985. Contract AC21-82MC19403. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86001589.

This report summarizes work conducted by the Institute of Gas Technology on a conceptual gas cleanup system for removing sulfur-containing compounds and HCl from coal-derived fuel gases at temperatures greater than 1000°F. The gas cleanup system under investigation consists of two separate processes. In one process known as the IGT mixed metal oxide process, a fixed bed of metal oxide-containing sorbents removes the sulfur-containing compounds by reaction. The sulfided sorbent is then regenerated with an oxygen-containing gas to produce elemental sulfur. In the other process, a fixed bed of molten carbonate-containing sorbent removes the HCl by reaction. The spent sorbent from this process is either disposed of or reprocessed externally. Both experimental testing and preliminary cost projections have been conducted for the two processes. The experimental testing phase of this program has included laboratory-scale testing of potentially useful sorbents for both processes and larger-scale testing of superior sorbents under simulated process conditions. The preliminary cost projection phase has included the evaluation of several different regeneration schemes for the high-temperature fuel gas desulfurization process and an estimation of the cost of using the molten carbonate sorbent for HCl removal.

37012 **(DOE/NASA/17088—5) Status of commercial fuel cell powerplant system development.** Warshay, M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Coal Utilization and Extraction). Aug 1987. Contract AI21-80ET17088. 9p. (NASA-TM—89896; AIAA—87-9081; CONF-870804—12). NTIS, PC A02. File Number DE87011605.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

This paper tells us where we are in the commercial development of fuel cells, where we are headed, and, in the author's opinion, how and when we are going to get there. The paper focuses primarily on the status of the development of commercial Phosphoric Acid Fuel Cell (PAFC) powerplant systems because the PAFC, which has undergone extensive development (both in and outside the USA), is currently the closest fuel cell system to commercialization. Shorter discussions are included on the high temperature fuel cell systems which are not as mature in their development (the Molten Carbonate Fuel Cell (MCFC) and the Solid Oxide Fuel Cell (SOFC)). The alkaline and the Solid Polymer Electrolyte (SPE) fuel cell systems, are also included, but the discussions are limited to their prospects for commercial development. Currently, although the alkaline fuel cell continues to be used for important space applications there are are no commercial development programs of significant size in the USA and only small efforts outside the USA. The story for the SPE commercial development is very similar.

37013 **(PB—87-182200/XAB) Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986.** Breen, S.P.; Merten, G.P.; Smith, R.M. (International Fuel Cells Corp., South Windsor, CT (USA)). Dec 1986. 47p. (FCR—8244). NTIS, PC A03/MF A01.

The report examines the accuracy of the simplified analysis methods presented in Application Guide for Fuel Cells in Commercial Buildings for characterizing and understanding the energy requirements of prospective applications for fuel-cell energy service. A breakdown of the energy characteristics of buildings within the light industrial sector is also provided. Based on 40-kW fuel-cell operating data from the field test program, diagnostic procedures were formulated and the instrumentation required to improve diagnostics for future power plants has been identified.

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

*REFER ALSO TO CITATION(S) 36750*

37014 **(PNL-SA—14605) The value of conservation in the Pacific Northwest.** Serot, D.E. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 3p. (CONF-8705154—1-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011988.

From 21. Pacific Northwest Regional Economic conference; Seattle, WA, USA (1 May 1987).

Objective of this study is to determine the time value of conservation in the Pacific Northwest. Because the Pacific Northwest depends on hydroelectric resources for the bulk of its generation, water supply, not generating capacity, is the critical factor in defining the time value of conservation. We explore this question in two stages. First, we look at the effects of the annual patterns of water supplies and electricity demand in the Pacific Northwest. Second, we look at the effects of time on the price of electrical energy sold to the Pacific Southwest during periods of adequate energy supplies, using a simulation model.

## 3201 Buildings

*REFER ALSO TO CITATION(S) 37013, 37277*

37015 **(AD-A—179142/5/XAB) Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986.** McKenna, C.; Munis, R. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA). Energy Group). Jul 1986. 155p. NTIS, PC A08/MF A01.

This report is designed for use by facilities engineers as a guide in the initial phases of investigating building diagnostics equipment and techniques. It provides information related to energy management and building environmental considerations resulting from energy conservation measures. Subjects covered include: 1) building enclosure-system evaluation; 2) heating, ventilating, and air-conditioning (HVAC) system evaluation; 3) lighting/illuminating system evaluation; 4) electrical-system evaluation; and 5) indoor-air-quality measurements.

37016 **(ANL/CNSV-TM—184) Institutional Conservation Program evaluation project: Results of higher education survey pretest.** Bernard, M.J. III; Collins, N.E.; Ettinger, G.; Hatfield, B.; Kammerud, R.; Kier, P.H.; Melillo, J.; Vine, E. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011237.

Teams from Argonne National Laboratory, Lawrence Berkeley Laboratory, and the US Department of Energy visited 14 colleges and universities to pretest a survey instrument that will be mailed to all US colleges and universities to solicit information about energy conservation activities and decision-making processes. The results of the pretest, the final higher education questionnaire, and implications for an elementary and secondary education questionnaire are the primary subjects of this report. Because interviewees offered anecdotes and advice about equipment, management, finances, and maintenance that may be useful to others, narrative summaries of each visit are included. The report also contains the interviewees' responses to the pretest questions.

37017 **(ANL/CNSV-TM—185) Institutional Conservation Program Evaluation Project: Results of hospital survey pretest.** Collins, N.E.; Hatfield, B.K.; Kier, P.H.; Sinha, L.S.; Vine, E.L. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011235.

As part of a study of energy conservation efforts in schools and hospitals and an evaluation of the Institutional Conservation Program sponsored by the US Department of Energy (DOE), teams from Argonne National Laboratory, Lawrence Berkeley Laboratory, and DOE visited 15 hospitals to pretest a survey instrument (in the form of a 10-page questionnaire and a list of definitions) that will be sent to 1800 hospitals to solicit information on their energy consumption, energy conservation activities, and decision-making processes. The pretest had several purposes, including identification of problems in the survey instrument's format and in the wording of instructions and questions. This report covers all aspects of the pretest. Characteristics of the hospitals and of the interviewees are discussed. Pretest procedures are described and responses to some of the survey questions are provided. Narrative summaries of selected interviews, containing informative anecdotes, are included in an appendix, as are technology transfer ideas and the final version of the survey instrument.

37018 **(ANL/ES—150) Projecting market demand for residential heat pumps.** Teotia, A.P.S.; Raju, P.S.; Karvelas, D.; Anderson, J. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011898.

Primarily because of technological improvements and sharp increases in energy prices after the 1970s energy crises, the sale of residential electric heat pumps rose ninefold from 1970 to 1983. This report describes current and future market demand for heat pumps used for space heating and cooling. A three-step approach was followed. In the first step, the historical growth of residential electric heat pumps was analyzed, and factors that may have affected market growth were examined. Also examined were installation trends of heat pumps in new single-family and multifamily homes. A market segmentation analysis was used to estimate market size by categories. In the second step, several methods for forecasting future market demand were reviewed and evaluated to select the most suitable one for this study. The discrete-choice approach was chosen. In the third step, a market penetration model based on selected discrete-choice methods was developed to project heat pump demand in key market segments such as home type (single-family or multifamily), new or existing construction, and race-ethnic origin of household (black, Hispanic, or white).

37019 **(BFR-D—5-1986) Occupant influence on energy consumption in single-family dwellings.** Lundstroem, E. (Swedish Council for Building Research, Stockholm). Mar 1986. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752391.

The objective of this study is to provide an explanatory model for total energy consumption in electrically heated single-family dwellings, based on publicly available socio-economic records in Sweden. An earlier study based in 3,200 houses, divided into 93 groups of similar design, has shown that energy consumption for one house may be twice that of another house in the same area, built to an identical design. The problem is: how much of this scatter depends in occupancy behaviour? The present study is based in 78 similar houses, electrically heated, built as one group in 1969. Data have been collected for a 10- year period from public records on individual occopants and houses. The explanatory ability of the model turns out to be low, as only about 20 percent of the total spread in electricity consumption between households can be accounted for. On the other hand, it has been found that half the spread in electricity consumption between households can be explained by total (hot and cold) water consumption. Some of the findings have already been published in report T46:1982 (in Swedish) from the Swedish Council for Building Research.

37020 **(BFR-G—10-1986) Heat pumps. Assesment of research and development projects for the three- year period from 1981/1982 to 1983/1984.** (Swedish Council for Building Research, Stockholm). 1986. 63p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752393.

A review of current and (in particular) concluded projects within the heat pump sector indicates that development is tending more towards consolidation of various technologies than towards development of new ones. Earlier reviews carried out by the Group revealed a high content of spectacular ideas, so this calmer development phase can be regarded as both logical and correct. The same pattern of development can be seen in the market, where there is an increasing tendency for a small number of simplified operating principles applications are exhaust air, outdoor air and rock

heat, particularly for appartment buildings, while the use of surface earth heating has not correspondingly increased and is restricted almost entirely to detached houses. This latest review and summary of the research and development status of heat pump technology is based mainly on BFR projects, although it naturally also includes experience from other sectors in its assessments and conclusions. The BFR projects that have been reviewed cover the three-year period from 1981/82 to 1983/84.

37021 **(BFR-R—10-1986) Dense in a right way. Energy aspects on the expansion of Gothenburg.** Linderstad, H.; Wennerhag, P. (Swedish Council for Building Research, Stockholm). 1986. 118p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752395.

The consumption of energy by the working places, dwellings and transport is estimated. Four alternative building structures which are located peripherally show a consumption which is 400 GWh higher per year than at central premises. The specific consumption of energy, kWh per m/sp2/ and the use of cars show similar tendency. (G.B.). With 23 refs.

37022 **(BFR-R—38-1986) Sorption - compression heat pumps and heat transformers. Technology and economics - a feasibility study.** Morawetz, E. (Swedish Council for Building Research, Stockholm). 1986. 96p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752392.

The objective of this project has been to illuminate the technical, economic and development status of combination heat pumps, i.e. heat pumps combining an absorption process with mechanical vapour compression. Mechanical vapour compression can be applied at a number of points in an absorption or resorption process. The simplest type, the mechanical resorption heat pump, in which vapour is compressed between the low-pressure and high-pressure levels of a resorption process, is of particular interest. The resorption-compression heat transformer, with low-pressure booster, is the most interesting of the sorption-compression heat transformers. It can be used when temperature levels in the heat source and heat sink are unsuitable for operation of a single-stage thermal absorption heat transformer. Competitiveness of the mechanical resorption heat pump, the resorption-compression heat transformer and the two-stage absorption heat transformer for steam production were investigated. The results indicated that, for electrical energy costs below 25 oere/kWh, the mechanical resorption heat pump was the most economic. Depending on the value assigned to the steam, the heat transformer may be more economic at higher electricity prices. For electricity prices up to 81 oere/kWh, the resorption compression heat transformer of the German company TCH Thermo-Consulting-Heidelberg offers better operating economics than Hitachi's two-stage absorption heat pump.

37023 **(CONF-870174—1) Testing thermal insulations with a thin-heater apparatus.** McElroy, D.L.; Graves, R.S.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). Jan 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010604.

From 5. meeting of the Building Thermal Materials Committee; Washington, DC, USA (7 Jan 1987).

Building materials research tasks sponsored by the Department of Energy are summarized. The features of a "thin-heater" apparatus to measure the thermal conductivity of insulating materials are described. The results of three error analyses show this technique can be accurate to 2% or better. Steady-state thermal conductivity data are presented for a fiberglass batt, an aging foam, heat flux transducers, and evacuated panels; transient test results are also reported. Calculations on an edge guarding technique predict reduced measurement errors.

37024 **(CONF-870564—1) Minority participation in new energy technologies: A case example of electric heat pumps.** Teotia, A.P.S.; Raju, P.S.; Karvelas, D.; Anderson, J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011431.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

Primarily because of technological improvements and sharp increases in energy prices after the energy crises of the 1970s, the sale of residential electric heat pumps rose ninefold from 1970 to 1983. However, growth has been uneven with respect to black, Hispanic, and white households, even after one controls for income and geography. This paper analyzes the growth in heat pump sales; estimates heat pump market share by key segments; and compares patterns of heat pump ownership by black, Hispanic, and white households. A discrete choice model was used to project the demand for heat pumps by black, Hispanic, and white households for new single-family and multifamily homes, which account for a major share of heat pump shipments to the residential sector. The study is based on several data sources, including the 1980 Census, the 1980 Annual Housing Survey, and the 1980 to 1981 Residential Energy Consumption Survey. Given the availability of consumer survey data, this model can easily be adapted to analyze the participation of different ethnic households in the growth of other new energy technologies.

37025 **(CONF-870804—10) Evaluation of power control methods for free-piston Stirling engine driven heat pumps.** Griffin, F.P.; Domingo, N.; Chen, F.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010597.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A free-piston Stirling engine (FPSE) driven heat pump will tend either to stall or to overstroke if the FPSE power output is not controlled or matched to the compressor power requirement. Ambient temperature variations can create large changes in the power required to compress the refrigerant. An analysis was performed to investigate power control options for FPSE heat pumps. Six different FPSE power control methods were analyzed to determine their effect on the thermal performance of a heat pump system. The six control options are: (1) a displacer gas spring average volume control; (2) a displacer gas spring damping valve control; (3) a displacer alternator control; (4) an engine average pressure control; (5) an engine compression space average volume control; and (6) a compressor clearance volume control. Predicted engine efficiencies were best for control options 4 and 6, and worst for options 2 and 3. The heat pump heating and cooling capacities were most nearly optimum for option 3, and worst for option 4.

37026 **(CONF-870811—2) Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky.** Berry, L.; Vineyard, T.; Bledsoe, J.; White, D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010888.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

Gas heating system retrofit pilot programs for low-income households were conducted in Minnesota and Kentucky in 1985. These programs were aimed at improving the cost effectiveness of low-income residential conservation programs by demonstrating and encouraging the transfer of gas heating system retrofit technologies into existing weatherization assistance programs. To determine the fuel savings and cost effectiveness of the four gas heating system retrofit types, an experimental design with random assignment to treatment and control groups was implemented. The Princeton Scorekeeping Method (PRISM) was used to measure fuel savings by comparing treatment and control group consumption for the year before and the year after the retrofits were installed. Cost effectiveness was estimated by calculating the net present value of the retrofits. Only one of the retrofit types, heat extractors for warm air furnaces, produced statistically significant net fuel savings (8%) in both Kentucky and Minnesota. The power gas burner produced statistically significant net fuel savings (6%) in Minnesota but not in Kentucky. The electric vent damper and electronic ignition produced significant net savings in Minnesota. The thermally actuated vent dampers did not produce significant savings in either location. The heat extractor was not cost effective. The power gas burner was cost effective with an average lifetime of ten years or more. The electric vent damper and electronic ignition were cost

effective with an average lifetime of fifteen years or more. The thermally actuated vent dampers were not cost effective.

37027 **(DOE/BP—63585-1) Energy use test procedures for appliances: A case study of Japanese refrigerators.** Meier, A.K. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011910.

The energy test procedure provides a consistent measurement of refrigerator energy consumption, which can be used by engineers, utility forecasters, and consumers. The US and Japanese test procedures for refrigerators differ significantly, so it is impossible to directly compare the performance of unique features, or even determine which units are more efficient. The energy use of twelve Japanese refrigerators (of which nine were unique models) were measured under the US DOE energy test procedure and compared to that reported by the manufacturers under the Japanese test procedure. The Japanese refrigerators used substantially more electricity with the DOE test.

37028 **(DOE/CE/24444—T1) [1984 Alliance to Save Energy/DOE Cooperative Agreement].** (Alliance to Save Energy, Washington, DC (USA)). 5 Mar 1987. Contract FC01-84CE24444. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010657.

The report outlines the tasks listed in the Cooperative Agreement's Statement of Work (as amended by the Management Plan submitted September 1984) and the major activities the Alliance completed to meet each task requirement.

37029 (DOE/CE/27460—T25, pp 2.7-2.22) **Undoing uncomfortable summer heat islands can save gigawatts of peak power.** Akbari, H.; Taha, H.; Huang, J.; Rosenfeld, A. (Lawrence Berkeley Lab., CA). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technolngies.

Man has created summer heat islands of daily average intensity of 3-5°C, adding to discomfort and increasing in air conditioning loads. (For example the Los Angeles basin uses 5 GW of air conditioning, thus tying up $10 billion of power plants and another $5-10 billion in HVAC equipment). They have been studying how to mitigate this heat, with increasing the amount of urban vegetation as an example. They first discuss the major factors that create the heat island, its magnitude and impact on residential cooling energy use, and mitigation techniques. They then simulate building cooling demand as a function of the heat island intensity. Simple heat island energy balance models are used to predict the changes in dry bulb temperatures that are then used as input to DOE-2 hourly simulations. The DOE-2 results enable them to rank measures for preventing the urban heat island. Their preliminary results indicate that planting trees can save as much as 34, 18, and 44% of residential cooling demand on a hot summer day in Sacramento CA, Phoenix AZ, and Los Angeles CA, respectively. The cooling energy savings are 53, 33, and ~ 0%. Direct shading of a house itself yields only 11, 6, and 12% savings in peak power in the same locations. 16 references, 2 figures, 3 tables.

37030 (DOE/CE/27460—T25, pp 2.23-2.26) **Membranes improve insulation efficiency.** Bullock, C.A. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

It has been determined from extensive tests involving test models and home attics that loose fill and fiber batt insulation does not function as expected by the industry. The reason for this deficiency is current test methods do not accurately predict the magnitude of air infiltration into fiber insulation as used in home attics, radiant heat infiltration into the insulation during summer, or radiant heat loss through the insulation during winter conditions. The use of (1) moisture permeable membranes over the insulation, and (2) layered membranes between fiber batts to form closed cells in the insulation both dramatically improve the efficiency of the fiber insulation. The efficiency of this insulation will be improved to an even greater degree if these membranes reflect radiant heat as well as reduce convection air currents. Extensive tests have also been conducted which show that if moisture permeable membranes are used over fiber insulation, the moisture content of the insulation will be reduced. 1 table.

37031 (DOE/CE/27460—T25, pp 2.27-2.30) **Cross-comparisons of new energy-efficient houses.** Busch, J.F.; Goldman, C.A. (Lawrence Berkeley Lab., CA). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Preliminary results from a project which compiled energy performance data on low-energy homes in the US, Canada, and Europe provide data on the actual performance of occupied buildings to let architects and builders know how well calculations and computer models actually predict energy performance and dollar savings. The measurements were part of the Buildings Energy-Use Compilation and Analysis (BECA-A) project. The buildings were separated into four climate zones for comparison. The results address only heating performance, but later performance studies will broaden the data base to include specific design features, comparisons of measured energy performance with design predictions, examination of incremental costs, and other factors. 2 references, 1 table.

37032 (DOE/CE/27460—T25, pp 2.31-2.32) **Options for reducing energy use in manufactured housing.** Conlin, F.; Paulos, S.K. (North Carolina Alternative Energy Corp.). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Low cost and availability have kept mobile home so popular that they represent as much of 50% of new utility connections in North Carolina. The lower energy efficiency of these buildings has led to numerous analysis and simulation projects, one of which learned that the options of enhanced insulation packages or the use of a heat pump can reduce annual energy use as much as 30%. The project also identified barriers preventing energy-efficient options in the areas of both buyer skepticism and seller resistance, the lack of a utility standard, and competition within the industry. A demonstration program will attempt to improve marketing strategy for energy-efficient mobile homes.

37033 (DOE/CE/27460—T25, pp 2.33-2.46) **Domestic hot water service in Lumley homes: a comparison of energy audit diagnosis with instrumented analysis.** DeCicco, J.M.; Dutt, G.S. (Princeton Univ., NJ). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The domestic hot water (DHW) system in a 60-unit, six-story apartment building was analyzed using billing data, energy audit data, and detailed performance data obtained from instrumentation. The system configuration has central storage tanks heated by steam from a gas-fired boiler and uninsulated distribution piping with recirculation. Recent renovations that replaced the tank, heat exchanger, pump, and controls, kept the boiler and distribution system. Estimates of thermal and volumetric DHW loads used gas meter billing data, indicating possible system inefficiency in meeting end-use needs. Consumption estimates included the service load supplied plus various loss components using procedures such as

those available to a walk-in energy auditor. Intensive microcomputer-recorded measurements of water flows and temperatures in the system refined and validated the audit-based diagnoses. The diagnostic techniques were able to identify the major heat loss components in the water heating system as the boiler on- and off-cycle losses (especially for the large winter boiler), and heat losses from the distribution system. The DHW efficiencies were around 20% in the summer, rising to 30% or more in the winter when the boiler also provides space heat, if boiler losses are charged to the space heating system. Detailed monitoring also showed that hot water consumption patterns averaged 22 gal/apt.-day with peaks in the morning and early evening. Eliminating the steam leak should halve the summertime gas use for water heating. Additional savings are possible through improved control of the hot water distribution pump and in new apartment buildings by specifying shorter runs and insulation for hot water piping. 12 references, 2 figures.

37034 (DOE/CE/27460—T25, pp 2.47-2.58) **Retrofit considerations in the multifamily sector.** DeLaHunt, M.J.; Baylon, D. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The multifamily sector shows significant potential for retrofit conservation. However, this sector has been ignored because of the programmatic difficulties inherent in the owner/tenant relationship. Over the past three years, Ecotope, Inc. has evaluated technical retrofit potential in about 200 multifamily projects in rural and urban areas across the US. This work has focused on electrically heated buildings and has included audits, conservation option development, simulation, and billing analysis. The buildings analyzed are typically lowrise and less than 50 units. This paper summarizes their results and observations, discussing the following points: (1) Window retrofits are the single largest source of conservation potential, providing approximately 50% of total sector savings. The addition of storm windows is widely applicable and generally has a calculated payback of 5 to 15 years. (2) Insulation levels in lowrise multifamily buildings constructed since 1955 are sufficient to preclude a cost-effective wall insulation strategy. (3) With the exception of attics, ceiling insulation retrofits should be installed at reroofing time to insure cost-effectiveness. (4) Infiltration rates tend to be lower in multifamily buildings than in single family homes built to the same standard. Natural air change rates to ambient of 0.3 ACH to 0.4 ACH appear to be typical in Seattle multifamily buildings. (5) Occupant effects are particularly important in monitoring projects, billing analyses, and realization of conservation potential in the multifamily sector, where turnover rates are high. In a small building, turnover or vacancy in one unit may significantly affect results for the building as a whole. 8 references, 3 figures.

37035 (DOE/CE/27460—T25, pp 2.59-2.74) **Conversion from central to apartment-level heating in multifamily buildings: the Asbury Park Village case study.** Dutt, G.S.; Linteris, G.T.; Englander, S.L. (Princeton Univ., NJ). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148. Contract FG01-85CE24422.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Asbury Park Village is a 126-unit public housing project in Asbury Park, New Jersey. This twelve-building complex was heated by a central gas-fired space and water heating system until 1983, when the central system was replaced by atmospheric gas-fired furnaces and water heaters located in each apartment. Total gas use fell by 53% at a simple payback period of about five years, not counting reduced maintenance costs. Engineering estimates of building heat loss agree with estimates derived from billing data analysis. The low efficiency of the old heating and hot water system appears to be the result of leakage from the distribution network, poor apartment temperature control, and possibly faulty steam trap or high off-cycle boiler losses. Conduction losses from distribution piping and condensate leaks could not have accounted for the poor efficiency. A comparison with alternative high-efficiency decentralized heating options indicates that fuel savings could have been about 65% with comparable payback periods. Of the alternatives, a somewhat novel approach involving three direct-vent space heaters and a high-efficiency water heater per apartment appears to be particularly attractive. 14 references, 3 figures, 4 tables.

37036 (DOE/CE/27460—T25, pp 2.75-2.87) **End use loads in multifamily buildings: some preliminary findings.** Esterberg, E. (Seattle City Light, WA). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Seattle City Light is monitoring three multifamily buildings with a total of 38 individually metered, electrically heated apartment units at the hourly end use level in order to understand existing electrical consumption patterns and to assess the conservation potential in this residential subsector. Preliminary results in one building with thirteen apartment units show that the winter load for the entire building was three times the average summer month's consumption, and there were no outstanding differences between weekday and weekend levels of consumption in either season. It was the daily patterns in various apartment units that most clearly reflected the behavior of occupants and the daily temperature fluctuations. Domestic hot water was the largest annual single end use (41% of the average unit's annual load) and was the dominant factor in producing daily peaks. Space heating was the most strongly seasonal and shaped the annual peak. Appliances, lights and other outlets comprised about 23% of the annual usage and showed the least seasonal variation. The housemeter, or common area usage, showed minimal seasonal variation and was equivalent to the total consumption of two average apartments. Space heating, as the dominant winter load in the dwelling units, is a logical target for utility energy conservation efforts. Shell improvements would be highly recommended. However, in terms of contribution to daily peaks, domestic water heating, the largest annual load, would be an appropriate candidate for peak shaving or peak shifting strategies. Finally, recommendations for further exploratory multivariate analysis using structural, demographic, and weather-related factors that may explain the wide variations observed among the dwelling units are discussed. 9 figures, 3 tables.

37037 (DOE/CE/27460—T25, pp 2.88-2.104) **Development of a computerized multifamily audit: technical and implementation issues.** Evens, A.; Burris, B.; Katrakis, J.; Becker, D. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

This paper describes the development of a computerized multifamily energy audit for the Chicago Energy Savers Fund (CESF), an energy conservation program recently initiated in Chicago. The CESF has committed $10 million in low-interest loans to finance energy conservation retrofits in low-moderate income neighborhoods. Since the programs beginning in 1984, over 200 buildings have received program services, including a computerized interactive energy audit, preparation of specifications for proposed work, bid management, construction management, and performance monitoring, depending on their level of progress. The CNT audit is important because it provides a low-cost tool for accurately estimating savings for the installation of energy conservation measures; thereby, making energy conservation accessible in low-moderate income neighborhoods. The paper describes the steps involved in calculating savings for the installation of energy conservation measures (ECM's). The various components of the audit are: utility bill analysis, building description, BIN method heat load model for simulation of energy consumption, savings calculations of non-interacted and interacted ECM's, and life-cycle costing methodology. Particularly of interest are the methods used for determining seasonal

efficiency and changes in infiltration. The paper also describes experience in training auditors from a variety of backgrounds to work in the 8 community based organizations; preliminary post-retrofit data which shows actual savings ranging from 20 - 50%; modifications and additions which have been made as a result of this experience; further development issues; and relevance of this experience to other localities. 10 references, 1 figure, 3 tables.

37038 (DOE/CE/27460—T25, pp 2.105-2.121) **Calculated and measured energy consumption for low energy houses.** Figley, D.A.; Snodgrass, L.J. (National Research Council of Canada). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

An increased awareness of residential space-heating energy costs has stimulated the development of a new type of housing technology often referred to as low energy construction. These houses incorporate a number of special features including air-tight vapor barriers, high levels of insulation, and mechanical ventilation systems. A microcomputer-based residential energy-analysis program named HOTCAN 2.0 has been developed in Canada and has become widely used for energy budget calculations. HOTCAN 2.0 incorporates a number of algorithms for calculating monthly heat flows through various building components and allows the building designer to evaluate the effect of changes in the basic building elements prior to construction. This paper outlines the results of a two-year energy analysis (HOTCAN 2.0 simulations) and field measurement study of 28 low-energy houses. The space heating, domestic hot-water heating, and interior electrical consumptions were individually measured on a monthly basis. Ventilation rates were monitored and occupant-related inputs were documented using a questionnaire. These data are compared with HOTCAN 2.0 calculated values. Various methods of analyzing the data are discussed. Good agreement between the average measured and calculated overall heat transfer coefficients was observed. However, the calculated below-grade heat losses were consistently low. Since the below-grade heat losses were a substantial component of the total space heating load, the calculated annual space heating requirements were also significantly lower than the measured values. The results highlight the importance of being able to input reliable data into an energy analysis program. The effect of an error in estimating the soil thermal conductivity is discussed. 14 references, 6 figures, 4 tables.

37039 (DOE/CE/27460—T25, pp 2.122-2.124) **Retrofit wall insulation study.** Flores, J.A. (Bonneville Power Administration). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The effectiveness of wall insulation retrofits to reduce thermal conductivity and heat losses depends upon how well the insulation is installed and the general construction of the building. A test by the Bonneville Power Administration on various installation techniques has only visual results to date, but it was possible to identify several trends involving the nature of cavities, the effect of wiring and venting paths, the densities around plumbing and switch boxes, and the role of soffits.

37040 (DOE/CE/27460—T25, pp 2.125-2.137) **Analyzing energy conservation retrofits in public housing: savings, cost-effectiveness, and policy implications.** Greely, K.M.; Goldman, C.A.; Ritschard, R.L. (Lawrence Berkeley Lab., CA). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Annual energy costs for the US's 1.2 million public housing units exceed one billion dollars. During the last decade, the US Department of Housing and Urban Development (HUD) and local public housing authorities have initiated major conservation programs. Their reviews of energy conservation work in public housing indicated that in spite of substantial retrofit activity, little documented information is available on energy savings from retrofits. In this paper, they calculate energy savings and economic indicators for 43 retrofits, using consumption and cost data collected from case studies, housing authorities, and utilities. These results are compared with savings from conservation measures in privately owned, multi-family housing. Heating system controls and window measures were the two most frequent retrofit strategies in the housing projects they examined. Median energy savings are 14% of pre-retrofit consumption, or 11.2 MBtu/unit-year; savings ranged from -7% to 62%. A median payback time of 12 years showed the retrofits, as a group, to be less cost-effective than a comparable sample of retrofit efforts in privately owned, multi-family buildings. They also examine the persistence of energy savings for a small sample of buildings for which they have several years of post-retrofit utility billing data; preliminary results suggest that proper maintenance is a critical factor in sustaining energy savings after temperature control retrofits in steam-heated buildings. Finally, they discuss qualitative factors that influence the acceptability of retrofits, including effects on comfort, building appearance, and security. 20 references, 3 figures, 4 tables.

37041 (DOE/CE/27460—T25, pp 2.138-2.140) **Measured energy savings from vent dampers in low rise apartment buildings.** Hewett, M.J.; Dunsworth, T.S.; Koehler, M.J.; Emslander, H.L. (Minneapolis Energy Office, MN). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Vent dampers which produce heat gain or reduce building air exchange can lower fuel costs. The differences between single-family and apartment buildings can change the potential heat savings. A monitoring program in Minneapolis of four hot-water and two steam-heated buildings checked fuel consumption with and without dampers and with various configurations of damper use. The results indicate those savings which are significant and the payback potential of damper controls in comparison with space heating using no damper control. 3 tables.

37042 (DOE/CE/27460—T25, pp 2.141-2.161) **Heating cost allocation in centrally heated rental housing: energy conservation potential and standards issues.** Hewett, M.J.; Emslander, H.L.; Koehler, M.J. (Minneapolis Energy Office, MN). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Heating cost allocation (HCA) can produce significant energy savings in the multifamily housing sector by making building occupants financially responsible for their energy lifestyle. HCA systems can help to contain building owners' costs and protect the housing supply while mitigating against mass conversion to individual heating systems. There is a need for standards to address (1) building energy codes, (20 equipment and installation, (30 allocation of non-metered uses, (4) disclosure and tenant education, and (5) meter reading and billing. All five are necessary to assure an equitable system. There is a need for a national effort to develop such standards using centralized resources, although standards which address the five issues can provide a framework for interaction among governments, landlords, tenants, and monitoring companies in the interim. 13 references, 6 figures, 2 tables.

37043 (DOE/CE/27460—T25, pp 2.162-2.172) **Umea energy savings blocks quality controlled programs save up to 40% energy in houses built in the 70's.** Hoegberg, E.; Nordin, C. (Meta Projecktplanering AB, Sweden). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The Umea project is one of the Energy Saving Blocks initiated by The Swedish Building Research Council in 1981. The project started in Spring 1982 and aims at trying full-scale activities for saving energy in existing houses. The following activities were included in this program: completion of the thermostat valves and adjustment of the heating system; water saving fittings; individual electricity submetering; retrofit by means of heatpumps and heat exchangers; triple glazing. In one of the houses a combination of activities has been carried out. In this house the consumption has been reduced from original 15,700 kWh per flat to 9600 kWh, or by about 40%. The remaining consumption, thus, is about 130 kWh per m2. In the Umea Saving Blocks they have proved that it is possible to save energy employing suitably selected activities, but that it often results in increased total costs. Also the management of the project is crucial for success. Top management and staff must be highly motivated and supportive. Specified requirements must be assured in procurement and installation. Pilot projects for testing before full scale operation are recommended. And the results should be followed up closely. A computerized energy statistics system has been required to keep energy consumption permanently at a low level. 7 figures.

37044 (DOE/CE/27460—T25, pp 2.173-2.187) **Reducing temperature imbalance in single-pipe steam buildings.** Katrakis, J.; Burris, B.; Catlin, T.; Fish, D. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Temperature imbalance among apartments in multifamily buildings can result in space heating costs up to 15% higher than found in properly balanced systems. It is determined that there are 20,000 single pipe steam buildings in Chicago and nationwide. This paper reports a methodology for correcting steam distribution imbalance whereby diagnostic techniques and the opportunity retrofit options are organized into a decision tree procedure. The approach presented will be useful for energy consumption service groups and mechanical contractors who wish to address the problem of imbalance in single-pipe steam systems. Detailed diagnostic testing procedures were set up to enable a community based or private service group to perform standardized tests to spot steam distribution and boiler problems. The instrumentation necessary varies from manual pressure gage readings to an on-site data acquisition system with multiple sensors. Some of the procedures can be carried out, depending on the instrumentation available, by balancing contractors. Even without instrumentation, building owners could conceivably carry out several of the standardized tests.

37045 (DOE/CE/27460—T25, pp 2.188-2.190) **Thermal and cost comparison of six superinsulated houses and one passive solar house in the Idaho residential demonstration program.** McSorley, M.R. (Idaho Dept. of Water Resources). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Figure 1 cost data is compared as an incremental cost from current practice defined in Idaho as FHA/VA Standards. Total incremental costs reflect supervision, design, construction loan interest, commission and tax, but not lot and builder markups. Vapor barrier costs are for ceiling, floor, and wall areas. All other costs are for single component-named areas. The total incremental costs are for dollars per square foot of floor area. Air-to-air (AAHX) costs are total installed costs for the unit and ductwork. AAHX average costs are high because of house #3, which has 492 linear feet of duct work. The AAHX has a 10 KW strip heater in it, which supplies all of the heat for this 3965 SF house. Total incremental costs for a 2145 SF house (average) are $7272, while average annual fuel bill savings are projected to be $488.85 per year at $.043/Kwh. Predicted energy budgets (Kwh/SF/yr.) were determined using the WATTSUN computer program or hand-calculated, using ASHRAE standard heat loss methodology. Actual energy budgets are based on the space heating Kwh for that monitoring period. The normalized energy budget is calculated from the site heating degree days and Kwh consumption to the normal (20-year average) heating degree days. The number 7 house, passive solar, had a high energy budget because the available sunshine was 33% below normal. The numbers 1, 3, 4, 5, and 6 houses had above-normal sunshine, while the number 2 house had approximately normal sunshine. 2 figures.

37046 (DOE/CE/27460—T25, pp 2.191-2.203) **Fuel savings analysis: house doctoring and storm windows.** Nadel, S.M.; Heineman, M.C. (Massachusetts Audubon Society). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

A three-year program by the Massachusetts Audubon Society (MAS) and the Massachusetts Executive Office of Communities and Development (MEOCD) has made fuel savings evaluations on the low-income weatherization programs operated by MEOCD with funding from the US Department of Energy and other sources. The study, which took place during the 1985-86 heating season evaluated the fuel savings attributable to exterior storm windows and house doctoring (the use of a blower door and other instruments to locate hidden heat leaks in a building, and the sealing of these leaks). Results indicate that house doctoring cut fuel consumption 8.9% +/- 7.6% (95% confidence interval) while storm windows cut fuel consumption 9.6% +/- 9.6%. Savings in a control group of untreated houses was 2.0% +/- 8.7%. The simple payback period for the house doctoring work (at an energy cost of $7.10 per million Btu) was 8.1 years while that for storm windows was 6.1 years. Comparison with the results of last year's MAS/MEOCD study show that house doctoring is less cost-effective than the full Weatherization Assistance Program (WAP) operated by MEOCD and approximately the same cost-effectiveness as standard caulking and weatherstripping work. Storm windows are effective at saving energy, but high cost, improper use, and deterioration due to exposure; makes them less cost-effective. Based on these findings, they recommend that storm windows remain and house doctoring have a low-priority until after higher priority weatherization measures have been undertaken. However, some aspects of house doctoring may be suitable for inclusion in MEOCD programs. 15 references, 2 figures, 1 table.

37047 (DOE/CE/27460—T25, pp 2.204-2.206) **Minnesota energy efficient house research project.** Nelson, B.D.; Robinson, D.A.; Nelson, G.D.; Hutchinson, M. (Minnesota Dept. of Energy and Economic Development). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The research project, which lasted from October 1983 to June 1985, identified factors affecting the energy performance of energy-efficient houses in Minnesota. The overall findings were that the houses were very energy efficient. Better attention to detail, following the builder guidelines suggested in this report, could have improved energy performance even more. Based upon economic evaluation, simple designs appear to be most cost effective. 1 figure.

37048 (DOE/CE/27460—T25, pp 2.207-2.209) **Results of construction quality inspections of 25 low-energy Minnesota homes.** Nelson, G.D. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

A summary of the Santa Cruz Summer Study report of August, 1986 highlights the findings of a highly instrumented inspection of 25 houses using a blower door, infrared scanner, wood moisture meter, sling psychrometer, flue gas testing equipment, and digital thermometers during the heating season. The inspection of air leakage, insulation defects, and mechanical systems found that the houses were not significantly tighter than conventional new Minnesota housing. Further research is needed to determine the cost of building the houses so that they would perform better. 2 references.

37049 (DOE/CE/27460—T25, pp 2.210-2.212) **Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings.** Nelson, G.D. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Findings of a study undertaken to determine the operating characteristics and to isolate the energy savings for a base-load boiler in a St. Paul apartment building cover energy savings for both hot water and space heating, as well as the efficiencies of the new and old systems. The report describes both the pre-retrofit and retrofit systems. 1 reference, 1 figure.

37050 (DOE/CE/27460—T25, pp 2.213-2.216) **Applications of thermography.** Nelson, G.R. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Infrared (IR) thermography using portable IR cameras and recorders to detect overheated objects can help to locate inefficiencies in electrical generation, transmission, and use. Applications include roof studies, retrofit inspections, and blower door surveys. IR thermography used by properly trained personnel is a valuable diagnostic tool, which can also act as an incentive to encourage better construction and as evidence to consumers that their high power bills are not necessarily the fault of the utility.

37051 (DOE/CE/27460—T25, pp 2.217-2.219) **Energy savings in 12 multifamily buildings retrofitted under a shared savings program.** Nevitt, R.M.; Stefanson, V.W. (St. Paul Energy Resource Center, MN). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Energy performance data for 12 multi-family buildings checked the accuracy of predictions made in earlier energy audits. The data include total building natural gas consumption on a bi-weekly basis, as well as submetered domestic hot water and space heat gas consumption at seven buildings. The results show significant energy savings at each of the 12 buildings, as well as a good correlation between measured and predicted energy savings. An economic analysis indicates that the average simple payback equals 5.3 years. The retrofit program incorporated strict quality control during installation and an on-going monitoring and tuning of building heating systems. 2 figures, 1 table.

37052 (DOE/CE/27460—T25, pp 2.220-2.228) **Measured performance of superinsulated homes in Montana: second report.** Palmiter, L.; Hanford, J. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Five all-electric superinsulated homes are being monitored in Eastern Montana. For each home, over a year's worth of hourly data on seventeen channels has been collected. The energy performance of these homes is consistent with expectations, and can be summarized as follows: (1) average annual 1985 space heat for three occupied homes in Great Falls was 5207 kWh (2.17 kWh/Sqft) in a year with 8218 base 65 degree days. The heating system provided about 34% of the total heating load, while internal gains provided about 53% and passive solar gains provided about 13%. (2) Space heat consumption varies by almost 2 to 1 between sites due to different levels of internal and solar gains, and different thermostat settings. (3) Average annual 1985 electric use of the three occupied homes was 20,077 kWh, of which 26% was space heat, 17% was water heat, 4% was dryer, and 53% was Other which includes everything else. 1 reference, 4 figures, 1 table.

37053 (DOE/CE/27460—T25, pp 2.229-2.243) **Generalized method to estimate the thermal performance of earth contact walls and floors.** Parker, D.S. (Northwest Power Planning Council, Portland, OR). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

A procedure is proposed that extends the Temperature Profile or Decremented Average Ground Temperature method (DAGT) into a more flexible form that can account for below grade wall and floor heat losses within a simple set of algorithms based on steady state heat transfer and plane geometry. The method can be used to model basements, slab on grade and crawlspace floor types. A significant improvement in the procedure results from estimating the decrement factors based on foundation depth. Performance of unheated spaces can be estimated using a zone temperature equilibrium model. Effects of soil conductivity, heat capacity and earth contact cooling effects are explicitly modeled. Provisions are made for estimating the effects of air infiltration and internal heat gains in the below grade space. The model gives good agreement with other methods such as the shape factor method of Mitalas and the dimensionless parameter method of Yard. 13 references, 3 figures, 4 tables.

37054 (DOE/CE/27460—T25, pp 2.244-2.256) **Recent results: SERI's development of advanced glazings.** Potter, T.F.; Benson, D.K. (Solar Energy Research Institute, Golden, CO). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Progress since these new window designs were presented at the 1984 ACEEE Summer Study is described. Laboratory tests of stress failure and thermal conductance of the R-10 vacuum window are continuing. Current results are presented that confirm previous conclusions, based on simulations, that such a glazing configuration is (1) possible and (2) a significant improvement over current low-emittance (low-e) window designs. Improved economic analyses are also presented. Further progress in developing solid-state electrochromic window coatings is described as well. Such coatings can provide automatic, electronic control over the admittance of daylight and solar heat gains through windows. In particular, the recent achievement in obtaining a neutral gray electrochromic coatings, significant in the optimization of daylighting benefits, is discussed. 7 references, 5 figures, 1 table.

37055 (DOE/CE/27460—T25, pp 2.257-2.259) **Japan's manufactured housing capability: a review of the industry and assessment of future impact on the US market.** Sackett, J.G. Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The Japanese manufactured housing industry uses computerized design and inventory control systems, assembly line production, robotics, and sizable research and development budgets in a high-tech housing approach. There are estimates that the industry will have 50% of the market in Japan in as little as five years. The cost of establishing a Japanese manufactured housing plant in the US would be high. Japan will first emphasize the export of building components applicable to conventional US site-built construction, then manufacturers will begin to bring their capability to the US through joint-venture or on large projects they develop themselves.

37056 (DOE/CE/27460—T25, pp 2.260-2.272) **Improving infiltration control techniques in low income weatherization.** Schlegel, J.A.; Hewitt, D.C.; O'Leary, L.A.; McCold, L.N. (Wisconsin Energy Conservation Corp.). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Infiltration control technologies have been the most frequently applied energy conservation measure in low-income weatherization programs. The common approach has typically utilized weatherstripping and exterior caulking in conjunction with window repair. In an effort to reduce costs while increasing effectiveness, a different approach to infiltration control was tested. A blower door was used to locate actual leakage sites. Time and level of effort guidelines were developed based on pre-retrofit air changes at 50 pascals depressurization (ACH50) to assist the weatherization crew in making work judgments. Two different methods for incorporating blower doors into the weatherization program were tested. One group of 18 houses received infiltration control work only, with an average expenditure of $106 in labor and materials, about 19% of the amount typically spent in Wisconsin. The other group of 31 houses received an average of $147 in infiltration related work in addition to other weatherization measures. Air change rates (ACH50) in both of the groups were reduced by about 15%, with 31% of the houses receiving no specific infiltration control work. The low-income houses in the study had lower pre-retrofit air change rates than anticipated (9.6 ACH50 average). The results indicated that use of a blower door and related field management procedures could lead to increased predictability of the effectiveness of infiltration control and that costs of infiltration work could be reduced while still significantly reducing air leakage in the house. 3 references, 9 figures, 2 tables.

37057 (DOE/CE/27460—T25, pp 2.273-2.275) **State of Minnesota high level weatherization project.** Shen, L.; Meixel, G. Jr.; Fagerson, M.; Nelson, G.; Wilson, T.; Belshe, R. (Univ. of Minnesota, Minneapolis). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The high-level weatherization study's purpose was to help the Community Action Programs find a cost-effective way to weatherize low-income housing. The study evaluated auditing techniques and the identified diagnostic procedures which would help auditors and work crews set priorities for individual houses. Preliminary findings indicate that houses with a high level of weatherization achieved 25% savings on average and 35% on heating only. These figures compare favorably with standard houses. The study also found inconsistent air change rates, which demonstrate a need to set individual air tightness measures for each house. 3 figures.

37058 (DOE/CE/27460—T25, pp 2.276-2.288) **Keeping warm: findings from the Kansas City warm room retrofit project.** Wagner, B.S.; Diamond, R.C. (Lawrence Berkeley Lab., CA). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

The warm room retrofit responds to a common problem: how to stay warm in a large, poorly insulated house during the coldest parts of winter. The problem is especially acute for low-income and elderly homeowners who may lack enough resources to improve the thermal integrity of their entire house. Although still an experimental technique, the warm room retrofit has the potential for achieving significant energy savings in houses at costs similar to those currently allocated by low-income weatherization programs. The retrofit is a combination of zoning, heating systems modification and insulation which allows the occupant to heat selected areas while maintaining the unused areas at a cooler temperature. The author reports results of a retrofit project in Kansas City, sponsored by the Urban Consortium in 1985-1986, of nine houses (including four controls). The houses are all single-family detached structures, occupied by low-income owners (with the owners' ages between 60 and 80 years), and heated with gas-fired forced-air or gravity-fed furnaces. The warm zone included the kitchen, bathroom, and one to two additional rooms, depending on family size. The costs averaged $1425 per house. Regressions of total gas use versus outdoor temperatures found that savings averaged 26%. They also measured indoor air quality before and after the retrofit. To determine occupant response and the acceptability of the retrofit, the residents participated in the design of the retrofits, and were interviewed after the retrofits were installed to determine improvements in comfort and their satisfaction with the results. 5 references, 4 tables.

37059 (DOE/CE/27460—T25, pp 2.289-2.301) **Thermabilt energy efficient residential construction research, demonstration and technology transfer.** Watson, R.H.; Silver, D.; King, S.; Burman, J.; Merrick, J.; Keegan, P. (Washington State Energy Office, Olympia). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Thermabilt is Washington State's component of the Bonneville Power Administration-funded Residential Standards Demonstration Program (RSDP). Under this program, 228 single family homes and 148 units in 19 multi-family buildings were constructed in Washington State during 1984 to high levels of energy efficiency corresponding to the Northwest Power Planning Council's Model Conservation Standards (MCS). Thermabilt had multiple objectives: Technology transfer - training what heretofore were primarily conventional builders in the methods of very energy efficient construction; Demonstration - broadly demonstrating very energy efficient construction to the shelter industry (builders, sub-trades, suppliers, realtors, appraisers, lenders) and the general public; and Research - determining the incremental costs and energy savings associated with very energy efficient construction. Despite these multiple and often conflicting objectives, tight timelines and a highly charged political atmosphere, Thermabilt was largely successful. The major objectives were satisfied. The success of the program played a pivotal role in the adoption of a significantly more efficient energy code by the Washington State Legislature. One of the nation's largest and highest quality body of data on the cost and performance of very energy efficient homes has been developed. Moreover, valuable lessons were learned in the areas of training, construction, technical assistance and marketing. This paper provides an overview of Thermabilt, its major accomplishments and the key lessons learned. 8 references,2 figures.

37060 (DOE/CE/27460—T25, pp 2.302-2.304) **Overview of the heat loss study for the Hood River Conservation Project.** Yoder, R.; Gardner, M. (Pacific Power and Light Co.). Aug 1986. ACEEE, 1001 Conn. Ave., NW, Suite 353, Washington, DC 20036. File Number TI87005148.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 2, Proceedings from the panel on small building technologies.

Comparisons of two models (SUNDAY and SHLM) which simulate energy use with the measured consumption of 246 houses led to a simpler form of the models using fewer houses and less detailed criteria. The authors describe the Hood River Project and compare the inputs of the two models, as well as variations in the houses, climates, and other details of the study.

37061 (DOE/CE/63503—T1) **Energy conservation business opportunities in multifamily housing: Executive summary and conclusions: [Final report].** (Center for Neighborhood Technology, Chicago, IL (USA)). Dec 1986. Contract FG01-86CE63503. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007148.

The local weatherization agency in Chicago is the City's Department of Housing (DOH). DOH contracted with the Center for Neighborhood Technology (CNT) to explore how these existing efforts, particularly in the multifamily sector, might be used to stimulate economic development ventures by non-profit groups. CNT sub-contracted with Charles Rial and Associates (CRA) and the Energy Resources Center of the University of Illinois at Chicago to undertake certain portions of the contract. Preliminary analysis focused on six energy conservation measures for commercial application in multifamily buildings. These were: (1) balancing heating systems; (2) window repairs; (3) window manufacturing and milling; (4) roof insulation; (5) bypass sealing/house doctoring; and (6) RCS/CACS Technical Services. Preliminary analysis consisted of a market survey mailed to selected building owners, preliminary market analysis, review of existing literature, and survey of competitive environment.

37062 (DOE/CE/63503—T2) **Energy conservation business opportunities in multifamily housing: Feasibility analysis/business plan for proposed residential balancing venture: [Final report].** (Center for Neighborhood Technology, Chicago, IL (USA)). 24 Dec 1986. Contract FG01-86CE63503. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87007149.

The City of Chicago's Department of Planning and the Center for Neighborhood Technology (CNT) engaged Charles Rial and Associates (CRA) to assess the initial feasibility of an independent residential balancing service as a venture opportunity for a community-based organization (cbo). This document represents CRA's final report on the feasibility of the proposed venture. To assess the feasibility of a residential balancing venture, CRA determined the market potential for such a service, reviewed the efforts of the Chicago Energy Savers Fund, and interviewed engineering firms and heating and boiler contractors. It was determined that a stand-alone venture that offers balancing as its service will not reach a broad enough market to support a break-even operation and therefore, does not represent a feasible venture opportunity. A more feasible approach would involve a joint-venture between an established heating/boiler contractor and a cbo. A summary of the findings that led to this conclusion is provided.

37063 (DOE/CE/63503—T3-Pt.1) **Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper: [Final report].** (Center for Neighborhood Technology, Chicago, IL (USA)). Dec 1986. Contract FG01-86CE63503. 84p. NTIS, PC A05. File Number DE87007150.

This industry assessment and concept paper was prepared by the Center for Neighborhood Technology (CNT) as a result of a grant from the US Department of Energy to explore energy conservation business opportunities which might be undertaken by non-profit agencies. CNT is interested in a Chicago-based manufactured housing factory for a number of reasons: This assessment therefore focuses on the feasibility of opening a manufactured housing in Chicago. It is based on a review of the current literature, of manufactured housing both here and abroad, and CNT's own visits to manufactured housing plants in the Chicago area.

37064 (DOE/CE/63503—T3-Pt.2) **Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report].** Rangelov, L. (Illinois Univ., Chicago (USA). Energy Resources Center). Dec 1986. Contract FG01-86CE63503. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007151.

The Center for Neighborhood Technology (CNT) with funding from federal and state sources is involved in a broad study examining the many economic and social issues of deteriorating neighborhoods. This study is only a portion of the major study, conducted by CNT, which will specifically focus on the adaptability of manufactured housing for the City of Chicago. Specifically this report focuses on: building codes regulating the construction of manufactured housing; manufactured housing construction process; current energy efficiency of manufactured housing; and Illinois manufacturers.

37065 (DOE/CE/63503—T3-Pt.3) **Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report].** Rangelov, L. (Illinois Univ., Chicago (USA). Energy Resources Center). Dec 1986. Contract FG01-86CE63503. 168p. NTIS, PC A08. File Number DE87007152.

This document is provided as an appendix outlining the building codes and energy efficiency standards for manufactured housing in Chicago.

37066 (DOE/SF/00098—T12) **Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data.** Piette, M.A.; Flora, D.; Crowder, S. (Lawrence Berkeley Lab., CA (USA); Battelle Pacific Northwest Lab., Richland, WA (USA)). Mar 1985. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011602.

Data were collected for 36 new non-residential sites designed to be energy-efficient in the Northwest. Eighteen buildings are offices; the remainder are mostly retail buildings, and schools. The data were collected and analyzed to evaluate the building energy standards proposed by the Northwest Power Planning Council. Almost half of the buildings are operating at energy levels under the proposed standards. There is a large range of energy intensities. The average office consumes 54 kBtu/ft$^2$-yr, while the average small office uses only 43 kBtu/ft$^2$-yr. Energy consumption for the eight retail buildings ranges from 47 kBtu/ft$^2$-yr to 134 kBtu/ft$^2$-yr.

37067 (DOE/SF/15774—T2) **Weatherization assistance program: Final monitoring report for Arizona; California; the Navajo Nation; Nevada.** (Stroud, Inc., Arvada, CO (USA)). Jul 1987. Contract AC03-85SF15774. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011265.

Stroud, Inc., was awarded a contract by the Department of Energy San Francisco Operations Office (DOE-SAN) to evaluate the weatherization program for selected grantees and subgrantees in Arizona, California, the Navajo Nation, and Nevada. The provisions of the contract specified an initial year and renewable optional periods of two (2) additional years. This report covers the monitoring of grantees and subgrantees for the first option year, or what is the second year of the contract. The first two (2) weeks of the second year's activities were devoted to scheduling the agencies to be monitored. The actual field monitoring began on October 14, 1986, and was completed on May 22, 1987. During this seven-month period, thirty-five (35) agencies were visited and evaluated under this contract.

37068 **(EUR—10285) Basic characteristics for low-cost houses in order to reduce the energy consumption for heating.** Dupagne, A. (Commission of the European Communities, Luxembourg). 1985. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752310.

In collaboration with CSTC, Belgium, TNO, Netherlands and BRE, UK a practical energy saving design methodology, based on a steady state simulation model for the behaviour of houses (LPB 3-4) has been developed in the First Energy Conservation R + D Programme (1975 - 1979). This methodology has been used for the design and construction of eight houses. The aim of this project was to validate the existing steady state model and to improve the design methodology by including simulation of the dynamic thermal behaviour of buildings (LPB 5) and by developing a conversational computerized version of the design guidelines. Also the investment, operating and maintenance cost has been included. After detailed design and construction, measurements have been carried out in five of the eight houses. In this monitoring project the measuring methodology was given priority. Simultaneously the design methodology has been computerized and is now available in the form of a users guide.

37069 **(FRNC-TH—2377) Proposal of a simplified model for building thermal behaviour simulation.** Roux, J.-J. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). 25 Apr 1984. 113p. (In French). NTIS (US Sales Only), PC A06. File Number DE87751772.

The aim of this study is to show that it is possible, using simplified hypothesises which consider physical phenomena, to develop feasible models for the thermic behaviour of buildings. These models require computer methods less complicated than those required by complex theoretical methods. They can be used on minicomputers which are generally becoming more accessible to users. Commencing with a detailed model which uses the method of finite differences, two levels of simplification have been developed mainly concerning the transfer of heat by conduction. The two simplified models, are verified by experimental results, and then compared with other detailed models. A critical analysis of the results and comparisons enabled the precision of each model to be estimated, and the respective domaine of application for each model to be defined.

37070 **(IIUG-pre—85-21) Energy conservation between environmental policy and consumer policy. Experience from eight countries.** Joerges, B.; Mueller, H. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1985. 47p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-06483.

Energy conservation policies and programmes directed at private households in Australia, France, Germany, Great Britain, Greece, the Netherlands, Sweden and the United States are evaluated and compared with respect to their energy and environmental conservation potential as well as their compatibility with consumer policy goals. Characteristic strengths and weaknesses of various programme types (governmental, business, consumer organisations, environmental organisations) at central and local levles are examined and conclusions for further research are drawn. Particular attention is givn to integrated, multi-agency, and multi-instrument approaches at the local community level and to the issue of implementing programmes in aid of low-income and tenant households.

37071 **(IVO-A—07/86) Impact of electric space-heating on comfort of living. Literature study.** Rantala, E.; Rantala, K. (Imatran Voima Oy, Helsinki (Finland)). 1987. 105p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752483.

This literature study deals with the impact of electric space-heating and of its various heat-distribution systems on comfort of living. The starting point has been Rohles' three dimensional comfort pattern which studies heat comfort as a function of large number of both physical and psychosocial variables. In the study the role of these variables on comfort of living is described and also needs of research are presented if adequate information couldn't be found. One of the main conclusions in this research project is that comfort of living can't be approached by studying man as a part of an environment containing only physical variables. There are in our environment of living many social and psychological variables with which a person is in complicated interaction. If these variables cannot be sufficiently taken into account, the conclusions drawn e.g. from laboratory studies on comfort of living may be inadequate in practice. The research project included also a survey made of consumer enquiries on the heat comfort of electric space-heating. The grievances obtained centered around the following topics: noise, draught, variations in the room temperature and the outerface temperatures of heaters.

37072 **(LBL—20545) A concept for an advanced computer-based building envelope design tool.** Selkowitz, S.E.; Papamichael, K.M.; Wilde, G.M. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 10p. (CONF-861109—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011091.

From 2. international daylighting conference: architecture and natural light; Long Beach, CA, USA (5 Nov 1986).

A review of current daylighting design tools indicates that over 30 tools are now available, including nomographs, protractors, overlays, and programs for micro-, mini-, and mainframe computers. Computer-based tools allow testing and analyzing of more design alternatives under a wider variety of conditions than was previously practical with slower techniques, but they have not fundamentally changed the information available to the design professional. These tools are applicable to certain limited functions of the design process and do not address the varying information needs of the designer at various points in the design process. We describe a concept for a computer-based building envelope design tool that is structured to overcome many of the limitations of the existing tools. The tool would address daylighting design in the context of the overall building envelope design, covering a range of environmental quality issues in addition to quantitative aspects of lighting and energy use. It would be useful throughout the process of design, construction, and occupancy, and is intended to provide important feedback that is often missing between those stages of the building's life cycle. A cost-effective tool with these performance features is not technically feasible using today's hardware technology. However, examination of the development of the necessary technologies provides strong evidence for future feasibility; accordingly, we are developing the tool to be used in a 1990+ time frame. To date we have studied the features and capabilities that such a tool should have, as well as several key areas, such as the design process, computer graphics, imaging systems, expert systems, and building science data bases.

37073 **(LBL—20896) Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues.** Piette, M.A.; Riley, R. (Lawrence Berkeley Lab., CA (USA)). Mar 1986. Contract AC03-76SF00098. 40p. (CONF-860303—8). NTIS, PC A03. File Number DE87010285.

From 13. annual energy technology conference and exposition (ET '86); Washington, DC, USA (17 Mar 1986).

Data have been collected and analyzed for 152 new commercial buildings from the US and abroad. Each building has some energy-saving or load-shaping features, including techniques such as solar heating and cooling, thermal storage, load management, daylighting, efficient HVAC, and sophisticated control strategies. The data base covers energy and cost data, architectural and system characteristics, building operations, and special features. In this paper, quantitative parameters covering energy use, peak demand, occupancy, operating conditions, construction costs, and energy costs are discussed. About two-thirds of the buildings are offices. The average BECA-CN office uses 66 kBtu/ft$^2$-year, which is about half the national office stock average. Measured energy use for these efficient buildings is roughly comparable to computer predictions for buildings designed to comply with the new ASHRAE Standard 90.1P. The average maximum peak electric demand is 5.5 W/ft$^2$ for the offices. Peak demand charges account for about 20 to 30% of annual electricity charges. Energy costs an average of $1.02/ft$^2$-year (in 1985 dollars) for the offices.

37074 **(MLM—3436(OP)) Single zone control systems.** Kapka, L.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 21p. (CONF-8704139—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009196.

From ASHRAE education seminar; Dayton, OH, USA (23 Apr 1987).

The number of old single zone systems which are operating today is quite high, providing numerous opportunities for retrofit to improve both space conditions and energy consumption characteristics. This report will cover the fundamentals of system controls applied to the single zone unit.

37075 **(NEI-DK—27) Efficient refrigerators with small compressors.** Mehlsen, K. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Apr 1986. 73p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752473.

Refrigerators in households account for app. 2.5% of the Danish electricity consumption. With the present trend towards use of more efficient refrigerators, this consumption is officially expected to be halved by the year 2000. In the year 2000 refrigerators with an electricity consumption of app. 12 W are expected to be available, whereas the best refrigerators on the market today consume app. 23 W. This project investigates means to improve efficiency of a prototype-refrigerator with no freezer compartment, where energy consumption has been reduced to 12 W. By using a very small and efficient compressor it is possible to improve the efficiency of the cooling process, and thereby a consumption of 8 W or even lower can be attained. In the long run it will be more cost-effective to develop such a small, efficient compressor instead of using the more common larger compressors, where the evaporator temperature can be increased by adding a heat capacity to the evaporator. Experiments have shown that besides the losses occurring at start of the compressor and at equalizing of pressure in the cooling system at stand-still of the compressor, losses also derive from unintentional transmission of heat, which so far have not been thoroughly investigated.

37076 **(NP—7770109) Metal-glass facades with an integrated heating/cooling/ventilation system.** Gelies, F.O. (Technische Univ. Braunschweig (Germany, F.R.). Fachbereich fuer Architektur). 25 Nov 1985. 203p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87770109.

An external wall construction, called an integrated facade, which includes heating, cooling and ventilation for the room inside, was the object of the study. The purposes of this study included the indication of the benefits, drawbacks and limitations of this wall with regard to its engineering efficiency and in a cost comparison for the investment and operational costs against other heating and ventilation systems, and opportunities or restrictions in constructional and architectural design. Moreover, hints were to be given for the restoration opportunities concerning existing metal/glass outside walls with the aid of this integrated facade in buildings that were not air-conditioned. Closer attention was paid to the development and preconditions (heating, origins of the integrated facade), functioning and constructional design and indoor air engineering conditions. Energy-related considerations are made of the room investigated in the study, and economic efficiency comparisons drawn up. Hints for the redevelopment of buildings with the aid of the integrated facade are given, and the influences of this type of facade on room use, constructional and architectural design are stated. (HWJ).

37077 **(ORNL/CON—196) Single-family building retrofit performance monitoring protocol: Data specification guideline.** Ternes, M.P. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011978.

A data specification guideline was developed for use in the US Department of Energy's (DOE's) Single-Family Building Energy Retrofit Research Program. A great deal has been learned regarding retrofit performance during the past decade through the analysis of monthly billing data collected on a large number of homes and from the analysis of more detailed data collected from a sample of homes. However, retrofit performance data collected from a significant sample of occupied homes and in more detail than billing data are required to address many research questions that remain unanswered. This guideline identifies the important data parameters that should be collected in research projects conducted by DOE and the private sector to address retrofit energy performance questions. Both one-time and time-sequential data parameters are identified and sufficiently defined to ensure that they are consistent and comparable between experiments. A minimum data set is identified, which must be collected in all experiments if the guideline is to be followed, in order that the observed energy savings can be normalized for outdoor temperature, indoor temperature, and internal load. Optional data parameters and data collection frequencies that can be collected to address additional research questions are also identified. These questions deal with the effects of occupant behavior, microclimate, and the distribution system on retrofit energy performance.

37078 **(ORNL/CON—229) Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota.** Berry, L.; Bledsoe, J.; Vineyard, T.; White, D.L. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011977.

Gas heating system retrofit pilot programs for low-income households were conducted in Minnesota and Kentucky in 1985. These programs were aimed at improving the cost effectiveness of low-income residential conservation programs by demonstrating and encouraging the transfer of gas heating system retrofit technologies into existing weatherization assistance programs. To determine the fuel savings and cost effectiveness of the four gas heating system retrofit types, an experimental design with random assignment to treatment and control groups was implemented. The Princeton Scorekeeping Method (PRISM) was used to measure fuel savings by comparing treatment and control group consumption for the year before and the year after the retrofits were installed. Cost effectiveness was estimated by calculating the net present value of the retrofits. Only one of the retrofit types, heat extractors for warm air furnaces, produced significant net fuel savings (8%) in both Kentucky and Minnesota. The power gas burner produced statistically significant net fuel savings (6%) in Minnesota but not in Kentucky. The electric vent damper and electronic ignition produced significant net fuel savings in Minnesota (5%). The thermally actuated vent dampers did not produce significant savings in either location. The heat extractor was not cost effective. The power gas burner was cost effective with an average lifetime of ten years or more. The electric vent damper and electronic ignition were cost effective with an average lifetime of fifteen years or more. The thermally actuated vent dampers were not cost effective.

37079 **(PB—87-184271/XAB) Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986.** Tchernev, D.I.; Emerson, D.T. (Zeopower Co., Natick, MA (USA)). Oct 1986. 160p. NTIS, PC A08/MF A01.

The breadboard prototype of a closed-cycle desiccant cooling system was designed, constructed, and its performance tested. The system combines the sorption properties of solid zeolites/refrigerant vapor pairs with the principle of regenerative heat exchangers. Since solid zeolites are difficult to move in vacuum-tight containers and in order to avoid intermittent operation, the desiccant is housed in two separate containers which are alternately heated and cooled by a heat-transfer fluid. Using the principle of energy regeneration, the heat removed from the container being cooled is recycled in the container being heated. The breadboard system, with 90 pounds of zeolite, demonstrated a recycling efficiency of 75% while the system capacity was 2,000 Btu/hr. This significantly increased the system thermal Coefficient of Performance (COP) to 1.1 at ARI conditions from the single-container thermal COP of 0.4. Modulating the transfer fluid-flow rate upwards increased system capacity to 6,000 Btu/hr with a thermal COP of .55 at ARI conditions. A weak dependence of capacity and COP on condenser temperature was shown. The nonlinear properties of zeolites eliminate the need for cooling towers to condense, thereby minimizing system first cost.

37080 **(PNL—5881) 1985 primary heating fuel use and switching: Assessment of the market for conservation in the Northwest: Phase 2.** Hattrup, M.P.; Nordi, R.T.; Ivey, D.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 79p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87010614.

This report presents information on the types of primary heating fuels used in residences in the Pacific Northwest region and how the heating fuels affect the level of investment in energy conservation measures (ECMs) by occupants of the residences. The types of heating fuel switching that occurred during the past two years (1983-1985) is also presented. The information was collected from random telephone surveys of households in Idaho, Oregon, Washington, and western Montana. The Pacific Northwest Laboratory (PNL) conducted analyses of the survey results for the Bonneville Power Administration (BPA) to obtain a better understanding of consumer attitudes and behaviors and to facilitate conservation program planning, design, and marketing. This report covers the following hypotheses: (1) there is no relationship between investing in ECMs and the type of primary heating fuel used in a residence; and (2) there is no relationship between the decision to switch to a new primary heating fuel during 1983-1985 and the original type of primary heating fuel used in the residence.

37081 **(PNL—6176) Technology diffusion of energy-related products in residential markets.** Davis, L.J.; Bruneau, C.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 137p. NTIS, PC A07/MF A01; GPO Dep. File Number DE87011231.

Acceptance of energy-related technologies by end residential consumers, manufacturers of energy-related products, and other influential intermediate markets such as builders will influence the potential for market penetration of innovative energy-related technologies developed by the Department of Energy, Office of Building and Community Systems (OBCS). In this report, Pacific Northwest Laboratory reviewed the available information on technology adoption, diffusion, and decision-making processes to provide OBCS with a background and understanding of the type of research that has previously been conducted on this topic. Insight was gained as to the potential decision-making criteria and motivating factors that influence the decision-maker(s) selection of new technologies, and some of the barriers to technology adoption faced by potential markets for OBCS technologies.

37082 **(TKK-KO/LVI—B11) Test equipment system to study the dynamics and the controlability of air conditioning processes.** Rintamaeki, K.; Siren, K. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1987. 124p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752477.

In this thesis an experimental system to study the dynamics and the controlability of air conditioning processes was developed. The full scale system consists of a main air handling unit, a ductwork an experimental room. The equipment and the structures of the system were designed in order to make their dynamic behaviour to correspond with that of typical office buildings in Finland. The air handling unit was built from standard components manufactued in the industry, the lenght of the ductwork is approx. 40 m and the floor of the room is made from hollow core slabs. The measurement instrumentation is all controlled by a computer and by the means of it impossible to get an extensive view of the state of the system as a function of time. The thermodynamic characteristics of the experimental room were studied experimentally by causing various errors of different type an size into the thermal balance of the room. Also the temperature gradients and the air velocities were measured. As a conclusion of these tests it can be stated that the heat capacity of typical office buildings in Finland seems to be big enough to make the changes in the room air temperature significantly slow. Futhermore, a previously developed thermal room model for control analysis was modified and verified to correspond with the experimental room. The simulation model works well if the period of the test is short, less than 2-3 hours.

37083 **(TKK-KO/LVI—B12) Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building.** Lindholm, M.; Sivukari, M.; Jaakkola, J. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1987. 132p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752478.

As a result of the research it was observed that there was a statistically significant relation between the air flow rates per persons and sensation of odor, stuffiness and dust. Increased air flow rates per persons seemed to decrease symptoms but increase noise caused by ventilation. The research revealed that employees working in open-plan offices complain more of draught, odor, stuffiness and noise than the employees working in cellular offices. According to employees the air was freshest if the ventilation system was mechanical exhaust and supply from the room. According to consulted employees, and increase of humidity increased the sensation of stuffiness, odor and dust and decreased the perception of dryness. There were no differences in the symptoms between the humidified and the non-humidified areas. Recirculation of air increased the perception of dust in the room, according to the consulted employees. Recirculation of air had however no effect on the symptoms. The number of exterior walls had a great influence on temperature, thermal sensation and draught. The number of exterior walls lead to a decline of temperature and increased the sensation of chill and draught. There was a significant relation between the perception of temperature and draught, although the air speed in a room was app. 5 cm/s. If a room was cold there was also a sensation of draught.

37084 **(TKK-KO/LVI—C12) Indoor air quality and ventilation requirements.** Seppaenen, O. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1985. 80p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752379.

The general goal of the research work is to define factors affecting the quality, healthiness and comfort of indoor air, to establish design values for consultants and manufacturers and to develop new systems for the control of indoor climate. The primary oject is to collect data and improve the understanding of various factors affecting the indoor climate. The final goal is the definition of limit values for various indoor climate parameters so that unnecessary energy consumption and health hazards are avoided. When ever feasible the comfort limits are used instead.

37085 **(TKK-KO/LVI—C19) Biological dusts in indoor air and factors affecting the bioaerosol levels.** Pellikka, M.; Pitkaenen, E.; Vilenius, P.; Kalliokoski, P.; Jantunen, M.; Tengstroem, J.; Nevalainen, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1985. 92p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752380.

The following main objectives were set for this study: 1) to find out whether a two way mechanical ventilation system with or without forced air heating can act as a source of dust, bioaerosols or allergens, 2) to compare natural and mechanical ventilations in relation to indoor air dust, bioaerosol and allergen levels, and 3) to study the effects of air humidity and humidification on indoor air dust and bioaerosol levels. Mechanical and natural ventilation systems were compared in 8 homes of comparable age and construction, located in the same suburb. 4 homes were equipped with forced air heating/ventilation, and 4 with natural ventilation. There was a dog in every home. The results indicate that forced air heated/-ventilated homes had somewhat lower particle counts than naturally ventilated homes. The obvious reason for this is the coarse particle filter attached to their heating systems. The fungal spores and bacterial counts were similar in both ventilation systems. The bed dust mite counts were below our detection level, 33 /g dust, and the mite allergen levels remained also below our detection level, 10 ng/M"3. The indoor air dog allergen levels varied <10-63 ng/m"3 and pollen counts <2-84 /cm"2/day. In the forced air heated homes also room inlet air counts of bacteria and fungal spores were defermined. In general inlet air levels were below the room air values, but in one living room inlet air the fungal spores

count was nearly two orders of magnitude higher than comparable recirculation and outdoor air counts. Viable aeroseol levels which could present a health risk were found in two samples from the previosly mentioned living room, and in one room air sample from a museum. Few correlations were observed between the measured variables. In addition to the mentioned negative correlation between humidity and fungal spores count positive correlations existed between coarse particle and bacterial counts in room air.

37086 **(TKK-KO/LVI—C21) Indoor air quality in new single family houses at Helsinki and Kuopio regions.** Raunemaa, T.; Ruokolainen, T. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 122p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752381.

The aim of this study was to investigate indoor air quality in single-family houses. The study includes formaldehyde, fungi, bacteria, radon and particle concentration as well as temperature and relative humidity. To find possible regional differencies the study houses were situated at two regions, Kuopio and Helsinki. The indoor air temperature varied between 20-28 deg C and relative humidity between 15-64%. Formaldehyde concentrations, which were clearly affected by relative humidity, ranged from <0.05 to 0.24 mg/m"3, being on an average 0.09 mg/m"3. Maximum acceptable formaldehyde level was exceeded in one of the study houses in summer. Bacterial and fungal spore counts were mainly below 2000 cfu/m"3, which can be regarded as the upper limit of normal concentration. Indoor fungal spore concentration depended on outdoor concentration and the bacterial concentration correlated with particle concentration. The levels of total suspended particles were mainly below 100 ug/m"3 with almost equal amounts for fine and coarse particles. The indoor concentrations followed the outdoor concentrations. The radon concentrations were below the recommended value in ll but one study house. The characteristics in the houses in Helsinki were found to differe from those in Kuopio in relative humidity values and in bacterial, particle and radon concentrations. All the measured parameters, except particles and radon, were higher in summer than in winter. Between full brick and full wood houses there were slight differencies in temperature, in bacterial and in fungal spore counts.

37087 **(TKK-KO/LVI—C22) Air conditioning at the working positions in an open plan office.** Huvinen, T.; Rantama, M. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 143p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752382.

This study examines the air temperature control range at one working position in an open plan office with various air conditioning systems. The study does not consider radiator heating and cooling or such appliances as fan-coil. For theoretical calculations a model was developed based on the idea of two-zone model. The model was tested experimentally with two methods of air distribution. A quite satisfactory correlation was achieved between theoretical values and experimental values measured. On the basis of calculations, air temperature can most be regulated if the inlet air diffusion point is directed into the working area, in which case the available control range precision would be +-1.5 deg C. In general the partition should extend to floor level if it is desired to have a temperature difference between the adjacent working places. The height of the partitions is not of very great significance if it varies from one and a half to two metres. Flow rate and temperature measurements were made on the diffusing equipment used to test the model. It was possible to deliver rather large quantities of air to the working area by means of an integrated panel in partition, without exceeding the permitted air velocity in the area. A difficulty proved to be the achievement of a sufficient blow at higher temperature differences. When a ceiling diffuser is used the inlet air cannot be very much colder than the ambient air temperature without causing draught.

37088 **(TKK-KO/LVI—C23) Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems.** Saari, H.; Kulmala, M.; Raunemaa, T. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 60p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752383.

Indoor particle concentration has been studied using different ventilation rates. Measurements were performed in large office buildings and by choosing different ventilation rates simultaneously in different rooms. Samples were collected on filters and analyzed by PIXE-method. The particle concentration indoors was obtained to be in a special way dependent on the particle concentration outdoors. When considering the elements originating from outdoor sources - like S and Fe - their indoor concentration increases with ventilation rate. For the elements emitted mainly indoors - like Cl - concentration decreases with ventilation rate. Thus variation of certain indicator elements is coupled with the ventilation rate. One important factor affecting the outdoor-to-indoor transport is mechanical filtration. Some impurities pass through these filters easier than others. In this study e.g. sulphur in fine particles was observed to penetrate a filtration unit easier than other elements. This is deduced to be coupled with S being smaller diameter than e.g. K, Ca and Fe consisting particles.

37089 **(TKK-KO/LVI—C24) Study on indoor air impurities.** Keskinen, J.; Kulmala, V.; Graeffe, G.; Hautanen, J.; Helmijoki, A.; Janka, K.; Kimmel, J.; Laaksonen, J.; Salminen, A. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 85p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752384.

Results of the study concerning indoor air impurities, carried out in 1983-85 by Tampere University of Technology, are reported. This study is part of a larger national indoor air survey founded by the Ministry of Trade and Industry and Finnish Academy. Aerosol particles, CO/sub 2/, air ions and radon were monitored continuously over one week periods in 19 Finnish dwellings and 5 office premices. Samples for determining the concentrations of certain organic gases and vapours of solvents and (in some cases) formaldehyde were also taken. In addition to this, time-averaged particle mass concentrations in two size fractions were measured. In some dwellings the measurements were repeated in different times of the year to find out the effect of climatic variations. Measured concentration vs. time data and records of the activities kept by the occupants are used to find out sources of impurities and reasons for concentration variations, as well as the behaviour and effect of ventilation. Measured concentrations are in general relatively low irrespective of the location, despite that the air exhance rates in small houses were found to be low, usually <0.3 l/h. Tobacco smoke was the only particle source to produce concentrations that can be regarded significant. House-cleaning and cooling were found to cause momentarily high particle concentrations. The average radon concentration of the dwellings (225 Bq/m"3) is relatively high even in Finland. This value is affected by the large portion of small houses. In two houses the radon levels were above 1000 Bq/m"3. In one of them the concentration could be lowered from 9000 Bq/m"3 to <1000 Bq/m"3 with inexpensive countermeasures.

37090 **(TKK-KO/LVI—C25) Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites.** Pellikka, M.; Pitkaenen, E.; Nevalainen, A.; Jantunen, M.; Kalliokoski, P. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 57p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752387.

This investigation was performed at 21 forced air heated homes, 11 daycare centers and 7 complain sites during winter and spring of 1985. Airborne bacteria, fungal spores and particle levels were measured together with air exchange rates under normal activity at each site. In the studied forced air heated homes the levels of particles and microbes in the room inlet air were generally lower than in the room air, but higher than in the outdoor air. The room inlet air was mainly filtered and recirculated room air with little

fresh air added. In winter (with snow cover) the outdoor air dust and microbe counts remained low, and the main sources were indoor activities. Normally the ventilation system reduces viable particle levels, but two individual exceptions were found. One was a site where allergic symptoms had been complained about and one inlet channel produced high levels of fungal spores. In one earlier study of ours another similar air channel was found in routine sampling. Exact sources were not found for either occasion, but obviously both dust and conduced or leaked moisture are needed to produce a flourishing mold culture in an air channel. Higher air exchange rates were associated with lower bacteria and coarse particle levels, but the levels of fungal spores were not affected (the major sources of dust and bacteria are indoors, and those of fungal spores are outdoors). The removal efficiency of mechanical filters improved by increasing dust loading, as expected, but deteriorated again when the filters had been used for more than 24 months, presumably due to leaks. In general, electrical filters were more efficient than mechanical ones. As expected, increasing the number of persons in the room increased both dust and bacteria levels but had no effect on fungal spores. Humidity and temperature affect room air microbial levels both through microbial reproduction and release into the air.

37091 **(TKK-KO/LVI—C26) Organic compounds evaporating from building materials into indoor atmosphere.** Jaemsae, S.; Kivistoe, A.; Ojala, M.; Saarela, K.; Waeaenaenen, M. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 82p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752388.

Volatile organic compounds evaporating from building materials produce odor to indoor atmosphere and may cause health hazards. The latest publications on organic compounds emitted by building and interior finish materials have been reviewed. These publications cover both laboratory and test room determinations of organic emissions from building materials. According to these publications, the major organic emissions consist of alifatic and aromatic hydrocarbons which are typical of solvents. Paints, floor and wall coverings and adhesives are found to be emission sources. This investigation concentrates besides the determination of the coventional solvents on determination of some specific organic volatile compounds like phenol. Different test chambers containing the samples have been compared. The use of a test room has been investigated in relation to the chambers. The emission of formaldehyde from building materials has during the past years been much studied in small scale test chambers in labortory conditions. In order to be able to exploit the results we have to know the interdependence between the formaldehyde emission values determined in chamber tests and those determined in practice in normal room conditions. To state this interdependence we have in this investigation studied some furnishing and covering materials. In addition, the influence of some circumstantial factors has been charted. Special attention has in this context been paid to the combined formaldehyde emission from several formaldehyde sources compared with the sum of formaldehyde emission from single sources. The factors influencing the uniformity of the air circulation in the test chamber were also clarified.

37092 **(TKK-KO/LVI—C28) Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality.** Kulmala, M.; Kulmala, M.; Raunemaa, T.; Saari, H.; Riihiluoma, V. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 105p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752385.

The human effect on indoor air aerosols has been investigated. The experimental part of the study was made in an ordinary apartment in Helsinki. The test programme includes the effects of cleaning and cooling. Also the importance of human activities indoor in general was observed. During a period of 7 weeks indoor and outdoor aerosol concentrations were measured by two fraction filter samplers. The filters were analyzed gravimetrically and by PIXE-method. Also deposition on surface was measured. A review based on litterature considering domestic materials and device was made. The cleaning period effects on indoor aerosol concentration. Cooking increases fine particle concentrations. Human activities increase coarse particle concentrations but have no effect on fine particles.

37093 **(TKK-KO/LVI—C36) Prerequisities for functioning of the natural ventilation.** Korkala, T.; Karvonen, M.-L. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1987. 173p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752479.

The aim of the study was to find the prerequisites for functioning and the limits of use of the natural ventilation, as well as possibilities of retaining the system in present stock of buildings. Furthermore, it was necessary to look for the possibilities of development and to create some basis for the developing of code of practice for design. Firstly, the study was performed as a wide litterature survey and investigation, where it was strived to give some information about the factors of natural ventilation and about the earlier studies. Secondly, computer calculations were made for both the model detached house and the model apartment building to find out the effects of the different factors in principle. Finally, rather wide field measurements were carried out in real dwellings starting from the general measurements of ventilation and ending up in precise measurements in chosen problem targets. The precise measurements were carried out with tracer gas and pressurization techniques. The concluding remarks from the study are presented in the end of the report in passage conclusions. Information about the performance of natural ventilation for further studies and for code of practice has been given there. Furthermore, the material presented gives some tips to consultants and manufacturers, too.

37094 **(TKK-KO/LVI—C39) Indoor particle concentration and the outdoor to indoor transport, Final report.** Raunemaa, T.; Kulmala, M.; Saari, H.; Olin, M. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 64p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752386.

Indoor paraticle concentration is affected not only by outdoor to indoor transport but also by several indoor sources, resuspension processes and deposition to floors, walls and other surfaces including particles themselves. A model of aerosol behaviour in indoor air has been investigated. By theoretical calculations and measurements filtration, ventilation, deposition, indoor sources and the effect of outdoor air concentrations have been examined. The aerosol concentration indoors was obtained to be dependent in a special way on the particle concentration outdoors. When considering the elements originating from outdoor sources - like A and Fe - their I/O-ratio increases with ventilation rate. For the elements emitted mainly from indoor sources - like Cl and K - I/O-ratio decreases with ventilation rate. The results of our model and the measurements agree with each other.

37095 **(VTT-TIED—649) Heat pump in a block of flats with warm air heating.** Saari, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio). Dec 1986. 85p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752482.

Energy and water consumption as well as the operation of the HVAC-system has been studied in a building complex located in Hyvinkaeae. The building complex consists of five separate buildings which have a common district heating plant. In addition each building is supplied with an exhaust air heat pump. The heat distribution from the heating plant to buildings is done by one-water system. In each flat there is a warm air heating unit. The volumetric (building volume 6975 m"3) heating energy consumption was 45.1 kWh/m"3/a. 39 per cent of the total heating energy was produced by district heating. The mean annual heatcoefficient of the pumps was 2.1. According to our measurements the low value of the mean heatcoefficient is due to insufficiently operating evaporator, high pressure drop in refrigerant circle and high condensation temperature. In winter there have been some complaints about low room air temperature. The rate of complaints was significantly reduced by balancing the warm air heating units. To some extent there were also complaints about the noise caused by the warm air heating units. As a whole, the HVAC-system was working proper-

ly. During the heating period the heat pumps were operating continuously and the additional heating power was taken from the district heating network to feed the total heat demand of buildings. During summer period the heat pumps were sufficient to produce all the heating power needed.

37096 **Measurement of single and double glazing thermal performance under realistic conditions using the mobile window thermal test (MoWiTT) facility.** Klems, J.H.; Keller, H. (Lawrence Berkeley Lab., Berkeley, CA). pp 424-430 of Solar engineering - 1987. Goswami, D.Y.; Watanabe, K.; Healey, H.M. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870307—). Contract AC03-76SF00098.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

The thermal performance of single glazing, clear double glazing, and double glazing with a low-emissivity coating was measured in both south-facing and north-facing orientations under realistic field conditions using the new MoWiTT field test facility. The time-dependent net heat flow through each fenestration was found to be consistent with the predictions of the standard simplified heat transfer model, provided that an angle-dependent shading coefficient is used and diffuse solar gain is included in the calculation.

37097 **Energy efficiency choice in the purchase of residential appliances.** Ruderman, H.; Levine, M.D.; McMahon, J.E. (Lawrence Berkeley Lab., Berkeley, CA). pp F208-F218 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC03-76SF00098.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

This paper provides a quantitative analysis of the behavior of the market for the purchase of energy efficiency in residential appliances and heating and cooling equipment. The authors examine the historical efficiency choices over the period 1972-80 for eight consumer products: gas central space heaters, oil central space heaters, room air conditioners, central air conditioners, electric water heaters, gas water heaters, refrigerators, and freezers. They characterize the behavior of the market for these products by an aggregate market discount rate. Except for air conditioners, the observed discount rates are much higher than real interest rates or the discount rates commonly used in life-cycle cost analysis of consumer choice. They appear to be relatively constant, even though fuel prices escalated rapidly over the time period. The authors conclude from these results that the market for energy efficiency is not performing well. Several explanations of the under investment in efficiency are proposed.

37098 **Superinsulated houses: The importance of resale value.** Holt, D. (U.S. Dept. of Energy). pp F119-F126 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

This paper analyzes how the mobility of the U.S. population, together with uncertainty in the resale value of an investment in high thermal efficiency of a house, may conspire to make those investments economically unattractive to a significant fraction of the new home market. Data on resale values are presented, along with numerical examples of total cost of ownership for investments in increased thermal efficiency in new single family dwellings. The short-run economic view of the potential homebuyer is contrasted with the longer-run economic view of a government agency or a utility company.

## 3202 Transportation

*REFER ALSO TO CITATION(S) 36416, 37021, 37161, 37184*

37099 **(PB—87-178257/XAB) Non-federal funding for transit systems: state-of-the-art case analyses. Final report, 1983-1985.** Brosch, G.; Bober, A.; Goodman, B.; Liske, K.; Parker, J. (Rice Center, Houston, TX (USA)). Mar 1985. 263p. NTIS, PC A12/MF A01.

The report explores projects supported primarily through non-Federal funding. These projects cover seven different funding mechanisms, which including both the successful elements of the financing methods and discussions of the obstacles encountered. They are presented in the form of case studies. The case studies are as follows: Denver, Colorado - Use of a special benefit assessment district to fund management and maintenance of the 16th Street Mall; Houston, Texas - Use of dedicated one-cent sales tax to fund purchase of Turnkey Park n Ride lots; Los Angeles, California - Use of voter-approved 1/2 cent dedicated sales tax to fund a three-pronged transit improvement and expansion program in Los Angeles, California (Parklabrea agreement) - Use of joint development combined with a special benefit assessment district issuing bonds (supported by assessment revenue) to fund a rail station; Montgomery County, Maryland - Use of total local funding of a feeder transit service through farebox revenues (30-40%) and local government subsidies; San Francisco, California - Use of tax increment financing of a rail station combined with private sector seed funding; and Washington, D.C. - Use of joint development of two metro rail stations combined with a congressionally-authorized multi-jurisdictional subsidy.

37100 **(PB—87-184933/XAB) Baltimore feeder-bus planning study. Final report.** (COMSIS Corp., Wheaton, MD (USA)). Sep 1986. 65p. NTIS, PC A04/MF A01.

The study reviews the process used by Maryland's Mass Transit Administration to plan the feeder-bus services for Baltimore's rapid rail line. It documents the procedures used in planning the bus operations and compares the projected patronage and cost characteristics of the services to those which were actually achieved.

37101 **(PB—87-186003/XAB) Innovative financing for transportation: practical solutions and experiences. Final report.** Hoel, L.A. (Virginia Univ., Charlottesville (USA). Dept. of Civil Engineering). Apr 1986. 424p. NTIS, PC A18/MF A01.

The report describes the proceedings of a National Symposium on Innovative Financing for Transportation, held in Fredericksburg, Virginia, on December 11-13, 1985. The Conference Proceedings Report includes papers or presentations delivered at four plenary sessions and three invited overview papers. Session papers cover a variety of subjects dealing with transportation financing including: New Approaches to User Charges; Recent Experiences with Benefit Assessment Financing; Development Financing and other innovative approaches and integrating financing techniques; and, Raising private capital. Overview papers focus on the variety of innovative financing options currently available and discussed financing issues from the perspective of urban and statewide transportation.

37102 **(PB—87-188348/XAB) Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report.** Earey, D.A. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Transport and Road Research). Feb 1986. 27p. (RT—17/86). NTIS, PC PC E05/MF E05.

Measured traffic-stream performance was used to produce mathematical models relating speed-change cycles to delay. These were combined with fuel consumption and wear and tear to produce costs for full and fractional stops. A range of cruising speeds and passenger-car equivalents are given to enable calculation of values for particular traffic stream mixes and cruising speed.

37103 **(PNL—5953) Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology.** Smith, S.A.; Davis, L.J.; Garrett, B.A. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011697.

The refrigerated trailer and container segments of the transportation industry are evaluated as potential entry markets for a proposed absorption refrigeration technology. To perform this analysis the existing transportation refrigeration industry is characterized; this includes a description of the current refrigeration technology, rating systems, equipment manufacturers, maintenance requirements, and sales trends. This information indicates that the current transportation refrigeration industry is composed of two major competitors, Thermo King and Carrier. In addition, it has low profit potential, some barriers to entry and low growth potential. Data are also presented that characterize the transportation refrigeration consumers, specifically, major groups, market segmentation, consumer decision process, and buying criteria. This consumer information indicates that the majority of refrigerated trailer consumers are private carriers, and that the majority of refrigerated container consumers are shipping companies. Also, these consumers are primarily interested in buying reliable equipment at a low price, and are quite satisfied with existing refrigeration equipment.

## 3203 Industry And Agriculture

*REFER ALSO TO CITATION(S) 36325, 36333, 36766, 36936, 36939, 37103, 37157, 37213, 37214, 37215, 37405, 37497, 37521, 37521*

37104 **(CEA-D—347) Low temperature heat recovery.** Dickson, G. (Combustion Engineering Association, London (UK)). 1986. 18p. (CONF-8601122—1). British Library, Boston Spa, Wetherby, West Yorks.

From Combustion Engineering Association meeting on low temperature heat recovery; Leeds, UK (14 Jan 1986).

The use of low temperature heat recovery techniques, with compact, efficient heat exchangers is demonstrated and the resulting fuel economy of Boiler and Process plant is discussed. Application of air and water preheat to industrial boilers, furnaces, kilns and ovens with minimal disturbance to existing plant and operating regimes is outlined. Improved fuel consumption efficiences with 6-24 months payback periods is reported.

37105 (CONF-8506355—, pp 1.1-1.19) **Two sensor measurement of slab temperature in reheat furnace: results of controlled trials on gas and oil fuels.** Beynon, T.G.R.; Ridley, I. (Land Infrared Ltd., Sheffield, England). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

The temperature of a steel billet in a reheating furnace can be estimated from a measurement of 3.9 micron radiance combined with a zone thermocouple reading. In controlled trials this very simple approach has proved applicable, with good precision, under a wide range of furnace conditions.

37106 (CONF-8506355—, pp 2.1-2.29) **Mathematical reheating furnace models in STEELTEMP.** Leden, B. (MEFOS Metal Working Research Plant, Luleaa Sweden). 1985. NTIS, (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Steeltemp is a finite-difference program for temperature and heat transfer analysis during teeming or continuous casting, cooling, stripping, heating, flat rolling and open die forging. Temperatures and densities of heat flow rate are calculated in a cross section of the steel. This is assumed to be rectangular or circular. Composite structures as liquid steel in an ingot mould, billet on a ceramic hearth, ingot standing against a wall in a soaking pit etc. can be analyzed. Various heat balances, time and isothermal plots can be printed out. In the reheating furnace models the heating curve of the stocks and the oxide scale formation can either be calculated from the measured furnace temperatures or from the geometrical and thermal description of the furnace, fuel and air temperatures, fuel and air flows, etc. Models for induction heating of stocks for rolling are also available. The reheating furnace models have been evaluated against pilot plant experiments made in the walking beam furnace at MEFOS, Metal Working Research Plant.

37107 (CONF-8506355—, pp 3.1-3.20) **Numerical analysis of heat transfer in continuous reheating furnace.** Abe, M.; Sugiyama, S. (Nippon Kokan K.K., Technical Research Center, Kawasaki, Japan). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

The quantitative analysis of heat transfer factors in reheating furnaces was done by using the modified Hottel's zoning method. The following results were obtained: 1. The optimum furnace height, which gives the maximum heating efficiency, is a function of the number of partitions in furnace length direction, and should be 4-5 m for relatively large number of parttitions. 2. As for by-product gases, the higher calory fuel shows the higher heating efficiency; however, the mixed gas of 3500 kcal per Nm/sp3/ of lower calorific value is sufficient as the supplying fuel. 3. The remarkable improvement in heating efficiency by oxygen enrichment can be achieved for low calory fuel; 9 per cent of oxygen enrichment shows 9.3 per cent of improvement for BFG, but only 6.9 per cent for COG. 4. Even a few cold slabs among hot slabs cause about 70 x 10/sp3/ kcal/t increase in unit consumption of fuel for simultaneous heating due to the unnecessary overheat in hot slabs. Except this step-wise increase at zero cold slab ratio, unit consumption of fuel has a linear relation with cold slab ratio.

37108 (CONF-8506355—, pp 4.1-4.18) **Modelling, simulation and optimization of heating of metal in reheating furnaces.** Ramachandran, N.; Kumar, S.; Aeron, S.M.; Chakraborty, P.C.; Sengupta, M. (Steel Authority of India Ltd., Ranchi, India; Bhilai Steel Plant, Bhilai, India). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

An investigation has been carried out to optimize the heating of blooms in 3-zone pusher type reheating furnace at Bhilai Steel plant, Bhilai, India. As a first step a two dimensional mathematical model has been developed. The model takes into account convection and radiation from gases and radiation from the wall, roof and bottom of the furnace. The heat conduction along the length and thickness of the bloom has been considered. The accuracy of the mathematical model was verified by carrying out measurements with test bloom. The model developed has been used to simulate the effect of different parameters like production rate, thickness of skid insulation, skid water temperature etc. on the fuel consumption. The parameter study has helped in designing a new water-cooled skid system. An optimum temperature regime has been computed with the help of the mathematical model for different production rates, stock sizes and quality of steel. The temperature regime forms the basis for computerized heating operation.

37109 (CONF-8506355—, pp 5.1-5.17) **Experiences of computer control of heating processes at Avesta Jernverk.** Jervered, B.; Meller, G. (Avesta AB, Avesta, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

During 1984-1985 Avesta AB invests about 9 millions SEK in order to improve the computer system for control of the processes in the heavy plate mill in Avesta. The program covers - superior computer control for walking beam furnace - exchange and modernization of process control by hot rolling - development computer - automatic untouchable measuring of thickness and length on ready rolled plates. The computer control of the furnace was installed during August 1984, the development computer Sep-

tember 1984, and the rest of the program will be completed during July-August 1985.

37110 (CONF-8506355—, pp 6.1-6.36) **Accurate temperature control of the reheating process at mixed cold and hot charging.** Hollander, F.; Zuurbier, S.P.A. (Hoogovens Ijmuiden the Netherlands). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

With respect to an accurate control of the reheating process the fluctuation in charging temperatures and the frequent changes between hot and cold charging (respectively between cold and hot charging) made it necessary to develop additions in the on-line furnace computer control system, which has been operating satisfactorily over 15 years now.

37111 (CONF-8506355—, pp 7.1-7.17) **Optimizing heat distribution in continuous furnaces using a dynamic mathematical model.** Fontana, P.; Boggiano, A.; Furinghetti, A., Pastorino, B. (Italimpianti S.p.A., Genova, Italy). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

An on-line dynamic model is the heart of the Italimpianti computer control system for continuous reheating furnaces. The physical structure of this model and the numerical methods adopted for its solution are described with some details, with the aim of showing which are the typical problems connected with real-time modelling and possible ways of facing them successfully. The other main component of the computer system is the 'control logic', i.e. the function performing the optimum set-point control starting from the mathematical model results. Whilst the basic statement of this function is quite simple - to make the actual thermal profile to overlap the optimum one - its practical actuation is not only a matter of choosing the right theoretical approach, but also of solving a number of practical problems connected with plant operation. The good performances of this system are confirmed by industrial users' experience. To this purposes data regarding furnaces of different kinds are reported.

37112 (CONF-8506355—, pp 8.1-8.17) **Reheating furnace automatization.** Millamon, P. 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Modern automatization techniques using computer make it possible to considerably improve the reheating furnace performances. These improvements concern: - discharging temperature accuracy - energy consumption. It should be noted that the reduced consumption results from the following factors: - more accurate discharging temperature which makes it possible to discharge at lower temperatures since the safety margin can be reduced - heating occurs nearer to furnace discharging end which ensures a good exhaustion of the heat contained in the waste gases - anticipated actions on the furnace: heat is introduced at the proper time - sojourn times in the furnace are planned with accuracy: it is then possible to define an economical heating curve as from charging and to comply with it all along the travel of the products through the furnace. The reheating furnace automatization system is thus a tool of prime importance for the proper operation of a rolling plant. It becomes essential to modern production units and can be a very interesting modernization factor for a more economical operation in existing plants.

37113 (CONF-8506355—, pp 9.1-9.16) **Process control of continuous heating furnaces - strategy of a calculation model and operating results.** Schupe, W.; Schmid, K.-F.; Klammer, H. (MannesmannroehrenWerke AG, Muelheim, Germany, F.R.). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

The characteristic feature of the process control system is that it is based merely on calculations of the heating curve paths. It has been shown that it is unnecessary to correct the calculation parameters by measuring the material temperatures at the furnace discharge. The preliminary measurements required are carried out in the project phase in order to accommodate characteristic operating data of the furnace and adapt the mathematical model. Further investments approved at the beginning of this year within the Mannesman group relate to the process control of the following furnaces: - rotary hearth furnace (210 t/h) for heating round ingots with a diameter of 175 mm - walking beam furnace (210 t/h) for heating slabs to discharging temperatures of between 1100 degree C and 1250 degree C. Both projects are to be realized by the end of 1985.

37114 (CONF-8506355—, pp 10.1-10.15) **Energy saving by furnace automation.** Uetz, G.; Woelk, G. (AEG-Telefunken, Basic Industrie, Berlin, Germany, F.R.; RWTH, Aachen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

The automation of two pusher-type furnaces heated with heavy oil in a plate rolling mill is described. The automation aimed at setting optimum air-factor and temperature reference values of a conventional control equipment for each operation condition. These reference values were to ensure a regular heating-up to set drawing temperatures at extremely different steel qualities and rolling-stock dimensions as well as a troublefree combustion at lowest possible energy. The guarantee assumed by contract of 4 percent of saved energy when employing the process computer compared with the conventional manual operation could be exceeded in a performance test adhering to all technological aims, resulting in a value of 6.7 percent.

37115 (CONF-8506355—, pp 11.1-11.23) **Reheating furnace technology in Kawasaki steel corporation.** Ebihara, M.; Muto, S.; Sato, K.; Takeshima, R. (Kawasaki Steel Corporation, Kawasaki-cho Chiba City, Japan). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

After oil-crisis, the continuous reheating furnaces at Hot rolling plant, Chiba Works were revamped or newly constructed for the purpose of energy saving and products quality increasing. It was based on the furnace technology about high efficiency heating and slab uniformal heating. We introduce the furnace technology of K.S.C. as follows. 1. The best furnace profile to maximize heat efficiency is the box type without nose-portion or soaking hearth. (They are dead spaces of heat exchange.) 2. To apply the box type furnace profile, it is necessary to adopt side-wall burners, we have developed the variable flame burner called KS-burner (Kawasaki Sandwitch burner) to attain an ideal furnace temperature distribution in the direction of furnace width. (In the direction of slab length.) 3. To reduce skid-marks or other thermal distribution in slab, we have developed a skid beam-shift, etc. According to above mentioned furnace technology, all the soaking hearths in the continuous reheating furnaces were replaced with the lower fire zones, and skid beams were shifted at the soaking zone. As a result of this revamping, a 20 percent of fuel consumption and a 40 percent of skid marks were reduced.

37116 (CONF-8506355—, pp 12.1-12.21) **New slab reheating turnace of Sollac.** Biau, G.; Pierrard, H. (Sollac, Florange Cedex, France). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

As a part of the modernization program of its hot strip mill, aiming to increase coil weight, SOLLAC has replaced the existing

5 pusher types furnaces of a 100 t/h capacity each by one 350 t/h shifted beam furnace. This furnace is 54.7 m long and ranks among the largest existing, which provides for an extended thermal recovery. The fume temperatures and fuel consumption are comparable to those of the best slab furnaces. Besides, the furnace presents among other interesting features, a noticeable reduction in skid marks as a result of the shifted beam design in the soaking zones with reference to the location of the beams in the previous zones.

37117 (CONF-8506355—, pp 13.1-13.18) **New heating technique for improving product quality and an example of its application.** Kawabata, A.; Matsukawa, T.; Muranaka, K. (Nippon Steel Corporation, Tokyo, Japan). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

In recent years, reheating furnaces in the rolling process have been required to uniformly heat steel under various heating patterns and greatly varying combustion loads. To meet the requirement, a new heating technique was developed that uses open radiant tube (ORT). Fuel is burned in a ceramic radiant tube open at both ends and installed in the bottom zones of reheating furnace in order to control the flow combustion gas and obtain the desired distribution of heat flux, thereby heating the steel to almost uniform temperature. The ORT technique features the following: The ORT with the length related to furnace dimension can provide an almost uniform furnace temperature distribution in the direction of the burner axis. The furnace temperature distribution is almost stable against sharp variation in the burner combustion load.

37118 (CONF-8506355—, pp 14.1-14.17) **Use of oxygen for heating furnaces.** Saltin, L. (AGA AB Innovation, Lidingoe, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

With rising fuel prices and the increased risk of disturbances to our energy supplies, the use of oxygen can provide an effective way of reducing the consumption of fossil fuels and increasing the production capacity of existing plants in a large number of metallurgical and chemical processes. The method thus offers an alternative to costly new construction or alterations. The continually rising fuel prices will make the method increasingly widespread. Experience has shown that operational reliability is high and that furnaces can tolerate the increased oxygen concentration in the combustion air without the need of special measures. A condition for this, however is that the oxygen is introduced in the right way and that control and monitoring are correctly performed. A simple comparison of fuel saving can easily lead to the wrong conclusions; the production capacity is usually also improved, thereby offering a greater profit contribution, as no reconstruction of the downline equipment is normally needed. The method also increases the possibility of using lowcalorific fuels for high-temperature processes.

37119 (CONF-8506355—, pp 15.1-15.13) **Oxygen enrichment of continuous reheat furnace to increase productivity and reduce fuel consumption.** Burfield, L.J.; Petersson, M. (The Timken Company, Canton, OH USA; AGA Gas Inc., Cleveland, OH USA). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Oxygen enrichment has proven to be economical to reduce fuel consumption and increase productivity in the Timken Company's reheat furnaces. The oxygen enrichment system for the 100 ton per hour pusher furnace that heat billets for the 28 inch (711 mm) mill reheat furnace will be presented in detail.

37120 (CONF-8506355—, pp 16.1-16.15) **Modernization of soaking pit furnaces with the aim of achieving lower energy consumption.** Hellman, B. (SKF Steel Hellefors AB, Haellefors, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Seven soaking pit furnaces for heating of 3-ton ingots were rebuilt in 1982. A process control system embraced a microcomputer controlling temperature, air/fuel ratio, energy input, oxygen enrichment level and oxygen content in the flue gas. Total energy savings were about 19.5 percent, whereof oxygen enrichment contributed 8 percent, lower oxygen content in the flue gas 8 percent and the improved control system about 3 percent.

37121 (CONF-8506355—, pp 17.1-17.11) **Transverse pusher induction heater for bilets using medium frequency.** Fuchs, M.; Grossier, E. (Compagnie Francaise d'electrothermie industrielle, Mulhouse Cedex, France). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

In this paper, after a short reminder concerning its princciple, the advantages of the transverse pusher induction heater are examined: increased efficiency and smaller size. This description is completed by a summary of the tests realized on a 500 kW prototype, and the presentation of the first industrial applications of 1000 and 2000 kW.

37122 (CONF-8506355—, pp 18.1-18.10) **Induction heating in rolling mills - new ideas and applications.** Backlund, H. (ASEA Metallurgy, Vaesteraas, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

For many years ASEA AB has been involved in industrial application for induction heating. The first heaters were delivered in the beginning of the 1940's for smaller forging shops. Today the main activities for ASEA's induction heating equipment are oriented towards the steel production market. The idea is to combine steel process know-how with capabilities concerning electrical equipment. So far induction heating in rolling mills is concentrated to reheating of billets, blooms or slabs prior to the rolling process. In these cases conventional fossil fuel fired furnaces have been replaced. The reason is obvious, traditionally the one requirement for heating has been to obtain a temperature of the material that is suitable for the process. Thus this application was the target for the inductive technique. The technique has some characteristics that are well appreciated by the rolling mills. First of all induction heating is very rapid, because it is possible to reach very large power concentrations in the material to be heated. Some consequences of a short heating time are: Less scaling. Reduced start-up time for the plant. Reduced amount of material during heating. Simplified control. Secondly there is very little time needed for starting up the heating itself and the heater is close to cold when switched off. However, there are also factors which are not conducive for the use of induction heating for conventional purposes. Modern fossil fuel fired furnaces are efficient and perform very well. Cost for electric energy are generally high. Induction heating is normally too advanced for simple heating cases.

37123 (CONF-8506355—, pp 19.1-19.22) **Localized inductive heating of steel products.** Jouet, J.; Georges, Ph.; Hellegouarc'h, J. (IRSID, Maizieres-les-Metz France; CEM Systemes SCAM, Bagnolet Cedex, France). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

This text relates to the use of induction in localized such as reheating of strips edges at the hot strip mill. During rolling in hot strip mill, transverse thermal heterogeneities appear (temperature gradient up to 70 degree C between centre and edge of the strip), leading to trouble such as: - edge crack and surface defects - local wear on work rolls in the finishing mill - overheating of slab in the reheating furnace. The reheating of the strip edges on the delay

table is already practiced in Japan, using gas burners or inductors. IRSID and CEM (Compagnie Electro-mecanique) have developed the 'CLIPS' system (induction system for localized reheating of steel products) in order to acquire the knowledge for designing industrial equipments. The first experimental results show the adequation of the inductor to the heating profile; an optimization of the process should lead to an efficiency of more than 50 percent.

37124 (CONF-8506355—, pp 21.1-21.23) **Replacement of petroleum based fuels with lean gas in reheating furnaces.** Vaclavinek, J.; Collin, R.; Zethraeus, B. (Royal Inst. of Technology, Stockholm, Sweden. Dept. of Heat and Furnace Technology). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Experiments have been carried out in a hot model, i.e. a small gas fired furnace, geometrically similar to a larger furnace. The purpose was to find if heating capacity could be maintained by modifications of the firing. The results show that for typical low calorific gases with a heat value less than 7MJ per m/sp3/n, the combustion air must be preheated to minimum 400 degree C and enriched with oxygen to 29 percent O/sb2/. The use of oxygen can be avoided by adding gas with high heat value to the low calorific gas, or preheating the gas. The excess air ratio should be minimized, but the increased waste gas loss must still be compensated with an increased fuel consumption. The waste gas system must be dimensioned for 10 to 50 per cent larger waste gas flow. When gas with medium heat value, 7 to 17 MJ per m/sp3/n, is used, air preheat in combination with increased fuel is sufficient to maintain the production. The waste gas system will not have to be changed. The quality of the heating, i.e. the temperature uniformity is not influenced by a change of fuel. The scale formation however, is a function of the hydrogen content of the fuel gas. No increased wear of internal furnace parts have been observed, in spite of oxygen enrichment of the combustion air. The emission of nitrogen oxides are considerably lower than when using conventional rich gases. The heat value and the analysis of low calorific gas may vary and a more sofisticated combustion system may be needed. It will therefore be necessary to modify existing control systems. These modifications should be included in a complete process control system based upon a reliable heat transfer model.

37125 (CONF-8506355—, pp 24.1-24.19) **Optimum design and energy saving measures of a new billet mill furnace.** Obashi, M.; Miura, T. (Mizushima Works, Kawasaki Steel Corporation, Kurashiki, Japan). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

A new billet mill which rationalizes to supply billets for the bar mill, with the practice of charging continuously cast steel to the reheating furnace in a short time, has been operated in Mizushima Works since Feb 1984. A new 6-zone reheating furnace was installed, of which the effective length is 34 m and the heating capacity is 350 TON/hr at hot charging. The aimed fuel consumption is 115 x 10/sp3/ Kcal per t. At cold bloom charging, furnace length of conventional energy saving type is long, but this new reheating furnace, which high temperature blooms are charged, was designed in the optimum shorter length. In this article, heat pattern, heat recovery ratios of waste gas, and heat balances in several furnace length are shown and the optimum furnace length is discussed. Further, energy savings measures such as reinforcement of insulation, low excess-air combustion by O/sb2/ analyzer, operation of divided walking beams, and process computers that support the furnace operation, are presented.

37126 (CONF-8506355—, pp 25.1-25.20) **Sophisticated reheating furnace with outstanding combustion control for high quality and energy efficiency.** Nakatsuka, M.; Uemura, M.; Mishina, K.; Kohama, S. (Kobe Works, Kobe Steel Ltd., Kobe, Japan). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

In April, 1984, a brand new reheating furnace for Rod and Bar Mill in Kobe Works began operation with a low fuel consumption rate of 214 x 10/sp3/ kcal/T. This reheating furnace is equipped with an automatic combustion control system, which is designed to achieve high quality and energy efficiency. This furnace is also designed to satisfy severe heating conditions as follows: 1. Quick and accurate heating to respond to the many kinds of steel grades. 2. To keep the internal temperature differences of materials within +- 15 degree C for accurate rolling. 3. To prevent decarburization of the billet during heating. In order to satisfy the heating requirements in this automatic combustion control system, we tested a simulation model by using the Zone Method instead of the 0/sbCG/ Method. Furthermore, the multi-fuel combustion burner of BOF gas and oil was developed in order to reduce energy costs. Therefore, by adopting the Zone Method, we were able to control the opposing characteristics regarding combustion and heat transfer of BOF gas and oil.

37127 (CONF-8506355—, pp 26.1-26.32) **Plant solutions to reduce energy consumption in reheating furnaces.** Soresina, R.; Arrighi, E. (Italimpianti S.p.A., Genova, Italy). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Most of the energy required for the hot rolling cycle is still used in the heating phase, therefore most efforts were concentrated in reducing the energy necessary to the process. The paper illustrates the new technology to optimize the efficiency and quality of reheating and energy recovery. The results of some industrial application of such technology are reported.

37128 (CONF-8506355—, pp 27.1-27.24) **Energy optimisaton at the Whyalla reheating furnace.** Abdelmalek, S.H. (Supervising Process Efficiency Eng., B.H.P. Co. Ltd., Whyalla, Australia). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Since the installation and commissioning of the 220 t/h I.H.I.Walking Beam Reheating Furnace at the Whyalla Steelworks in 1975, efforts have been devoted to improving the heating efficiency of this furnace. A program to optimize reheating furnace energy consumption commenced in 1978. Since then significant reductions have been achieved in specific energy consumption for all steel sections by changing heating practices. Monthly average specific energy consumption has been improved from over 3.0 GJ/tonne to less than 2.0 GJ/tonne. Some of these changes were, alteration of the proportion of fuel used in each zone of the furnace (7 zones). reduction of bar spacing the use of double strands of blooms instead of scattered strands and the use of mathematical modeling techniques to predict the effect of zone temperature changes on the temperature distribution in the heated blooms and blanks. The last mentioned improvement was established in conjunction with the introduction of a relatively simple computer control in 1981, which enabled refinement of the optimization program. As a result, the response of the furnace to rolling rate changes and to rolling mill delay situations has been improved. The relatively simple single line production facility at the Whyalla Steelworks means the energy demand pattern of the reheating furnace has a significant effect on overall by-product fuel gas management. The above improvements helped reduce peak energy demand and energy demand variability permitting more consistent gas availability to other energy consumer units.

37129 **(CONF-8706124—1) The economic feasibility of plastics recycling.** Curlee, T.R. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010590.

From Recyclingplas II conference; Washington, DC, USA (18 Jun 1987).

The purpose of this paper is to address the numerous factors that collectively determine the economic feasibility of technologies to recycle plastic wastes. A major point of the paper is its distinction between an assessment of feasibility based only on the expected direct costs and revenues associated with a technology and a more complete assessment that also considers relevant institutional and technological constraints. Summary information on the expected direct costs and revenues associated with different existing and developmental technologies is given. That information indicates that many processes are currently less costly than incineration and landfill in many areas of the United States. In addition, selected market segments where plastics recycling is and is not currently taking place are reviewed to suggest the economic and institutional factors that have contributed to the success or failure of recycling operations. These factors suggest the market segments that are prime candidates for future activities in plastics recycling. Evidence from markets where plastics recycling as a segregated waste has thus far been successful suggests that success has not come so much from technical fixes to the problem, but rather from favorable institutional and economic conditions. If the past is an indication of the future, we can expect that plastics recycling outside of the municipal waste stream will grow during the coming decade in selected markets where economic and institutional constraints are minimal. For those plastics that can not be segregated easily from other materials in the municipal waste stream, tertiary and quaternary processes that can accommodate various combustible wastes will continue to be adopted.

37130 **(DOE/BP/18945—T7) Energy conservation in the food industry: Follow-up report.** (United Industries Corp., Bellevue, WA (USA)). Jun 1986. Contract AC79-84BP18945. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011166.

United Industries Corporation (UIC) conducted an energy analysis at five food processing plants (SIC 20) in the winter of 1984-1985. Tour of plants (Alpac, Carnation, Terminal flour mill, Tree Top) were revisited eighteen months later to determine what energy conservation measures (ECM's) had been or would be implemented. Additionally, the follow-up investigation evaluated the actual energy savings that accrued for the implemented ECM's and recorded the plants' views on the usefulness of the energy analysis.

37131 **(DOE/CE/40539—02) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). Mar 1984. Contract AC02-82CE40539. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009319.

This project is part of a longer-range program whose objective is to establish a high efficiency prototype industrial power system that can burn coal directly. The power system consists of a slow-speed, two-stroke diesel engine and a fuel preparation system which provides clean micronized coal in a water slurry for use as the primary fuel. The project is divided into five tasks. This topical report deals with the subject of Task 2: Fuel Preparation, Beneficiation and Handling. The first part of the report consists of a comparative evaluation of the beneficiation technologies that can reduce the ash content in the coal to less than 1 percent, and a comparative analysis of the most important factors affecting the economics of these processes as a whole. The second part is a report of the slurry procurement effort and the preliminary screening tests that were performed on the slurries to determine which one will be used for the diesel engine tests scheduled.

37132 **(DOE/CE/40539—04) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 4.0, Single-cylinder engine tests.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). Apr 1986. Contract AC02-82CE40539. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87009321.

Purpose of the program is to foster the long-range development of a coal/water slurry fuel fired slow-speed, two-stroke diesel engine for efficient and economical power generation in the 8 to 30 MW range for use in industrial cogeneration applications. This report covers the results obtained in Task 4.0, Engine Test, in which four micronized and beneficiated coal/water slurries were utilized as a fuel in a single-cylinder version of the slow-speed, two-stroke diesel engine. Thermal performance, emissions and engine wear are reported on and evaluated in this report, based on the results of the testing program. The results of the program show that the slow-speed, two-stroke diesel engine can operate on coal/water slurry fuels at efficiencies approximately equal to those obtained with conventional liquid fuels and produces considerably lower amounts of exhaust emissions. The engine wear, particularly at the piston ring/cylinder liner interface is considerably greater than that which occurs with liquid fuels. However, it is concluded that by means of technological advances regarding cylinder liner and ring materials, design changes, and new concepts for the lubrication system, a reliable and economical coal/water slurry fired slow-speed engine can be developed.

37133 **(DOE/CE/40539—05) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 6.0 Determination of accurate heat release diagrams and mechanical efficiency.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). Feb 1987. Contract AC02-82CE40539. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009322.

Purpose of the program was to foster the long-range development of a coal/water slurry fuel-fired, slow-speed, two-stroke diesel engine for efficient and economical power generation in the 8 to 30 MW range for use in industrial cogeneration applications. This report contains the results of Task 6 of the program, a detailed analysis of heat release diagrams and determination of the mechanical efficiency for a single-cylinder, slow-speed diesel test engine when operated on coal/water slurry and diesel fuels. A digitized technique was utilized to determine the cylinder pressure history. The results of the program showed that the averages of previously reported thermal efficiency values for operation on coal/water slurry fuels were very accurate determinations. In addition, the slight differences in thermal efficiency between diesel and slurry operation are most likely related to changes in the mechanical efficiency resulting from degradation of the piston ring/cylinder liner interface rather than changes in combustion efficiency. Our previous prediction that, at 50% water content, the efficiency of a coal/water slurry engine is comparable to a diesel engine, has been confirmed experimentally and explained analytically.

37134 **(DOE/CE/40539—06) Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report.** Nydick, S.E. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). Feb 1987. Contract AC02-82CE40539. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009323.

Purpose of the program was to foster the long-range development of a coal/water slurry fuel fired slow-speed, two-stroke diesel engine for efficient and economical power generation in the 8 to 30 MW range for use in industrial cogeneration applications. Five Topical Reports have been prepared. This report contains a short description of the process used to select four coal/water slurries for testing in a single cylinder, slow-speed engine and the test facility and a summary of the program results. The program results conclusively showed that the thermal efficiency of a coal/water engine is comparable to that of a diesel fueled engine and produces considerably lower amounts of exhaust emissions. Furthermore, it appears that the slight decrease in efficiency observed for some of the slurries is related to the additional friction at the piston/ring cylinder liner interface when firing coal/water slurry fuels, rather than any differences in combustion. The engine wear, particularly at the piston ring/cylinder liner interface, is considerably greater than that which occurs with liquid fuels. However, it is concluded that by means of technological advances in materials, design changes and new lubrication concepts, are reliable and economical coal/water slurry slow speed engine could be developed.

37135 **(DOE/CE/40736—T1) Slow speed coal/water slurry fired diesels in industrial cogeneration: Market evaluation.** (BDM Corp., McLean, VA (USA)). 29 May 1987. Contract AC02-86CE40736. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011274.

Large bore, slow speed, diesel engines fired by coal water slurry (CWS) fuels for industrial cogeneration service are expected to be capable of also firing residual fuels to provide a flexible alternative to the natural gas and oil fired systems that are today's technology. However, their introduction into industrial service will depend heavily on economic and market considerations. This study has been performed to assess the factors affecting the relative economic performance of CWS diesel cogeneration systems and to define the potential industrial market available to such diesels. This assessment provides for a greater understanding of those factors having the greatest potential effect on the furture use of this technology, and can be used to assist in guiding ongoing and future research and development into those areas of CWS technology and application offering the greatest improvement in economic performance and market potential.

37136 **(DOE/ID—10150) Cost/performance analysis of high temperature waste heat recovery equipment: Final report.** Rebello, W.J. (PAR Enterprises, Inc., Fairfax, VA (USA)). Feb 1987. Contract AC07-76ID01570. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011703.

This report presents the results of a survey of currently available high temperature (above 1400°F) heat exchangers. Data from eighteen major manufacturers was collected and analyzed. A methodology to compare presently available commercial recuperators was developed. It was concluded that the factor, dollars per thousand Btu/h of heat transferred to the air, was more useful in comparing heat exchangers because it related the cost and performance of these heat exchangers. The data was presented in graphical format by size and furnace exhaust temperature. The curves should be useful in indicating how much new developments and technologies should cost to be competitive and how effective their improved performance or the use of substitute materials would be in reducing costs.

37137 **(DOE/ID—10171) Applicability of fracture mechanics to lifetime prediction of B and W ceramic heat exchanger tubes.** Reuter, W.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1986. Contract AC07-76ID01570. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012038.

Fracture mechanics concepts are used to predict a minimum service lifetime for silicon carbide heat exchanger tubes to be tested in a prototype industrial heat recuperator installation. Available data and the assumptions used are identified, the analytical procedures are described, and the results and implications are discussed. The primary conclusion is that no evidence exists to indicate that the service lifetime is too short to be useful. Based on the assumption that K/sub I/ < K/sub Th/, the predicted lifetime is unlimited for the specified initial flaw sizes. Additional conclusions relate to the scope and detail of further fracture mechanics studies necessary to more accurately predict service lifetimes for these ceramic materials.

37138 **(DOE/ID/12170—2) High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report.** Stillwagon, T.L.; Coombs, M.G.; Kotchick, D.M. (AiResearch Mfg. Co., Torrance, CA (USA)). May 1987. Contract FC07-81ID12170. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87012055.

Development has been completed of a ceramic recuperator and its companion high-temperature preheated combustion air burner. The system is designed to operate in a variety of industrial flue gas streams with exhaust temperatures up to 2500°F. The ceramic recuperator provides combustion air preheated up to 2000°F to the high-temperature burner. Development of low-pressure seals to join the ceramic recuperator components was performed as an integral part of the program. While operating at high temperatures, the recuperator requires seals effective in minimixing both leakage and stress concentrations in the joints between ceramic components. Seal design, composition, leakage performance, and seal characterization were evaluated for cement, glass, and fiber packing seals. Laboratory studies have demonstrated that effective, low-leakage seals were developed and incorporated into the HTBDR industrial design.

37139 **(DOE/ID/12560—4) Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing.** Shepherd, P.B.; Powers, T.J. (Manville Service Corp., Denver, CO (USA)). Jul 1987. Contract AC07-85ID12560. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012421.

A prior DOE study on ten candidate methods for recovering the energy resource represented in asphalt roofing waste showed that incorporating fresh factory waste in new roofing was a potentially viable means for recovering some of the annual $7 \times 10^{13}$ Btu in this waste resource. The project reported here involved measuring the effect of adding factory waste to the asphalt coating compound (called filled coating asphalt). The influence of waste type, size, and quantity on coating asphalt properties such as viscosity, impact resistance, pliability, and service life was measured. In addition, experiments were made to determine if there was a possibility of using field waste (worn-out asphalt roofing) in a similar manner.

37140 **(DOE/ID/12583—2) Optimum heat pump placement in industrial processes: Executive summary.** (TENSA Services, Houston, TX (USA)). May 1987. Contract AC07-85ID12583. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011039.

When heat pumps are integrated into industrial processes, using an adaptation of pinch technology, large energy savings are possible even with modest heat pump temperature lifts. If greater lifts prove to be economically possible with advanced heat pumps, these already impressive savings can be increased significantly. Improving heat integration through economically optimal heat exchange can have a dramatic effect on process energy consumption. ICI and others utilizing pinch technology in process design have been implementing this technology for some time and are now realizing the resulting energy savings and increased profits.

37141 **(ENEA-RT/FARE—85-3) Approach to a more rational use of energy in the textile area of Prato. Diffusion proposals and operative indications of intervention.** Tomassetti, G.; Vinella, S. (ENEA, Rome (Italy)). Jan 1985. 71 p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752630.

This report summaries ENEA activities performed during the last three years regarding energy conservation in the textile industry. It contains results of the analysis of the energy saving opportunities, both in terms of technology and its management, in the textile area of Prato.

37142 **(EPRI-EM—5231) The use of membranes in hybrid industrial separation systems: Final report.** Ray, R.J. (Bend Research, Inc., OR (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 198p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920482.

Objective of this study was to identify industrial separations amenable to processing via hybrid separations systems consisting of electrically driven membrane processes and conventional unit-separation processes, and to design and evaluate such hybrid systems for specific industrial separations. The rationale for developing hybrid systems is that the resulting separation system often offers significant advantages over the exclusive use of the component processes. Such advnatages may include reduced total energy requirements, lower capital, operating, and total production costs, and a more complete separation. Separations addressed in this study include waste and product streams from food processing, petroleum refining, and textile milling, and energy-recovery from industrial drying processes. In each case, a full design and analysis was conducted that allowed comparison of the conventional separation technology alone with the membrane-based hybrid system. In nearly all cases, hybrid systems containing state-of-the-art membrane technologies were shown to offer advantages over the conventional separation technology.

37143 **(EPRI-EM—5232) Industrial applications of freeze concentration technology: Final report.** Barron, T.S.; Heist, J.A.; Hunt, K.M.; Wrobel, P.J. (Heist Engineering Corp., Wilmington, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 242p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920472.

Often more energy-efficient than the separation technologies now in industrial use, freeze concentration techniques also offer advantages in product purity and quality. This applications analysis estimates that widespread adoption of freeze concentration could produce significant national energy savings, along with increasing baseload electricity consumption.

37144 **(IFU-B—55-83) Agricultural utilization of thermal waters - demonstration program. Pt. 2. Detailed scheme of the demonstration program 'Agricultural utilization of geothermal waters in Waltersdorf' and establishment of an individual investigation program. Final report.** Ettlinger, K.; Trauttmansdorff, K.E. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Sep 1983. 141p. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung.

The report abstracted discusses feasible ways of an agricultural utilization of thermal waters. Particular emphasis is on the cultivation of vegetables with thermal waters such as geothermal ground water, industrial waste water and the cooling waters of thermal power plants. With 13 figs., 5 tabs.

37145 **(NLH/IBT/R—196) Alternative energy supply systems for lettuce production in greenhouses.** Sebesta, Z.; Wenner, D. (Norges Landbrukshoegskole, Aas). Jan 1984. 44p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752496.

Economic evaluations of 5 different energy supply systems were made for greenhouses at 1000 m/sup 3/. Light conditions, plant growth and energy consumption was considered in view of the necessary investments the various alternatives implies. The plant production in greenhouses is an intensive way of production that requires considerable amount of initial investments or of payment of current energy expences. This applies to lettuce production also which is a low heat demanding culture. A "carrier" air-to-air heat pump of the type 38AQ 016, 4ORRO24 put in parallel to the oil heater is quicker paid for than 2 pumps of the same type. Heat pumps which are dimensioned for a long time of operation and a small specific investment demand give quick back payment of invested capital. Lighting with 100 W/m/sup 2/ in the 6 winter months doubles the winter production. The products in alternative 4 and 5 (growing with artificial light) becomes 5-11% more expensive than in alternative 1 (ordinary heating) even 10 years after the investments were made. These alternatives offer advantages that otherwise is not easily seen: Safer production, better product quality in the winter and better use of the work force. 27 tables, 7 drawings.

37146 **(NP—7770116) Optimized load distribution in supply systems with combined heat and power generation in consideration of the district heating network.** Braun, H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 18 Jun 1985. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770116.

The author discusses operations planning, i.e. power plant utilisation and load distribution in consideration of the district heating network. An outline of district heating in West Germany is followed by a description of the overall supply system, of the analysis of generation systems, the characteristics of network operation, and the limiting operating conditions. Particular regard is given to the modelling of the district heating network and the description of the optimisation procedure. The results are discussed and summarized. (HAG).

37147 **(NZERDC-P—116) The use of recovered heat for preheating air to spray driers.** Miller, E.J. (New Zealand Dairy Research Inst., Palmerston North). Jan 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900821.

Object of this NZERDC demonstration project was to appraise the many different heat recovery options applicable to spray drying plant in the dairy industry. This appraisal was carried out for a particular factor, the Christchurch plant of The Plains Co-op Dairy Company Ltd.

37148 **(PNL—6208) Lost conservation opportunities in the Pacific Northwest irrigation sector.** Harrer, B.J.; Hattrup, M.P. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012503.

Initial efforts in the study were focused on identifying potential lost opportunities. Results of these efforts resulted in the following measures being identified as potential lost opportunities in the irrigation sector: pumping plant efficiency improvements on both existing and new sprinkler irrigated acres, low-pressure irrigation on new sprinkler acres, and mainline modification and fittings redesign on new sprinkler acres. All of these potential lost opportunities except fittings design were subject to more detailed analyses through a survey of irrigation equipment dealers, pump repairers and country extension agents. Fittings design was omitted from the survey. Results of the survey indicated that only high-efficiency electric motors and correct pump selection methods on existing and new sprinkler systems and low-pressure irrigation on new handmove/sideroll systems should be considered lost opportunities.

37149 **(SJF-BERETNING—27) Energy saving by means of mutual adjustment of tractor and tools size.** Kristiansen, P.S.; Nielsen, V. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Oct 1986. 49p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752372.

The purpose of the project has been to study the practical possibilities of fuel-saving by correct mutual adjustment of tractor and tool and to study the possibilities of the most fuel-economical driving with the tractor. Different sizes of tractors and tools have formed part of the study. The influence of engine revolutions, choice of gear, tyre- and wheel mounting, 4-wheels drive, 2-wheels drive, wheel slip and driving conditions on the fuel consumption have been studied. (EG).

37150 **(STEV-TB—87-4) New machines for handling forest fuels.** Danfors, B.; Nordfjell, T.; Saell, H.-O. (Statens Energiverk, Stockholm (Sweden)). 1986. 104p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752407.

The report deals with new machinery systems for forest energy and technology for the combined forestry and agricultural firm and starts with a survey of the background and purpose of the study. Similarly, an account is given of the work which will lead to a number of project proposals. The report is designed to give introductory information on different problems, requirements etc., which will be of interest also to designers and manufacturers with limited knowledge of technology in forestry. There are considerable volumes of raw energy in cleanings, thinnings and clearfellings which are not used for one reason or another. A summary is given in the following different work operations in forestry and the machinery and tools used. Specifications show that modern technology and equipment can be improved in several respects. The main emphasis in the report is placed on the sector dealing with developmental inputs and economy in conjunction with the project proposals. These also include important sections dealing with specifications and a number of illustrations intended to clarify the text. The report ends with a discussion and conclusions. An important factor in increasing production of forest fuel is development of a large and stable market which can utilise domestically produced bio-fuels at attractive prices. (authors).

37151 **(TVA/PUB—87/18) Utilization of fluidized bed combustion waste: Final report.** Barnhisel, R.I. (Kentucky Univ., Lexington (USA); Tennessee Valley Authority, Chattanooga (USA)). 1987. 108p. NTIS, PC A06/MF A01. File Number DE87900884.

Spent bed materials (SBM) were evaluated as a potential liming agent in two laboratory and five greenhouse experiments. The effectiveness of SBM to change the pH of an acidic soil was

compared with $CaCO_3$. The germination and growth of alfalfa and soybeans was monitored in the greenhouse and the study also included chemical composition of the plants and changes in chemical properties of the soil. Excessive rates of SBM should be avoided until further information is developed as germination of small seeded crops were reduced and there may be a risk of formation of a "plastic" like material. When properly used, SBM may serve as a source for sulfate-sulfur, boron, and zinc. Concentrations of environmentally-sensitive heavy metals (Pb, Cd, Cu, Ni, and Cr) in harvested plant tissues were not related to treatment variables and in most the concentrations of these elements were below detection levels with no toxic effects being noted.

37152 **Thermal contact resistance in waste heat recovery systems.** Peterson, G.P. (Mechanical Engineering Dept., Texas A and M Univ., College Station, TX). pp 45-50 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

In order to improve the overall efficiency of energy recovery systems, it is necessary to understand the effect of the temperature gradients at the interfaces that exist between the individual components of these systems. Presented in this paper is a review of the analytical techniques developed for determining the thermal contact resistance occurring at these interfaces along with a discussion of the results of experimental programs designed to verify these analytical techniques. Three separate types of interfaces are presented and discussed; similar metal-to-metal contacts, dissimilar metal-to-metal contacts, and contacts in which an interstitial material is present.

## 3206 Municipalities And Community Systems

*REFER ALSO TO CITATION(S) 36333, 36680, 37013, 37146, 37840, 37855*

37153 **(ANL/MCT—87-1) Acoustic leak detection for district heating systems: Results of Phase 1: Laboratory assessment.** Kupperman, D.S. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011129.

Recent advances in commercially available acoustic sensors and signal processing have made acoustic detection of gas and fluid leaks cost-effective and efficient. As a result, a variety of industries are beginning to use acoustic leak detection systems. This report describes an effort to obtain laboratory-generated data to establish the effectiveness of an advanced acoustic leak detection system for finding, locating, and sizing leaks in district heating (DH) piping systems. Results of experiments carried out with DH insulated piping suggest that acoustic leak detection technology can be applied effectively to monitor, locate, and detect leaks in underground piping. Leak monitoring can be carried out with appropriately spaced acoustic sensors placed either on the pipe or on the ends of acoustic waveguides in contact with the pipe. Acoustic detection of leaks with flow rates of less than 10 gpm is possible in underground DH pipes. With advanced signal processing and sensors and under optimal conditions, the range of detection for steam leaks could be greater than 500 m and the location accuracy a few meters. Acoustic background noise and attenuation data from field pipes are required to accurately establish leak detection sensitivity and leak location.

37154 **(CONF-870366—1) Pyrolysis of municipal solid waste.** Helt, J.E.; Agrawal, R.K.; Mallya, N. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011540.

From Alternative energy in the midwest; Rosemont, IL, USA (18 Mar 1987).

The pyrolysis of municipal solid waste (MSW) is a potential method of producing useful fuels. However, past attempts to utilize the technology have resulted in facilities that have not performed as expected, producing low yields of inferior products. Background on past pyrolytic concepts and the current status of the technology are discussed. Most MSW is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. The end products of MSW pyrolysis are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium BTU content. Current DOE/ANL research has been undertaken to gain a better understanding of the basic mechanisms, kinetics, and chemistry involved in the pyrolytic conversion of MSW and its components. The objectives of this program, current research efforts, results to date, and future plans are discussed.

37155 **(DOE/CE/26526—T1) Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report.** (Lincoln, City of, NE (USA); Lincoln Electric System, NE (USA)). 27 Oct 1986. Contract FG01-85CE26526. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87009076.

This study attempts to examine the prospects of serving of a 16 block downtown area with a new district heating and cooling system. The system would deliver hot water and chilled water to the various buildings in the district who choose to be connected. The core of the system would be large water source heat pumps which would utilize waste water effluent from the Theresa Street Plant. By incorporating the heat pump into this system the waste water effluent becomes the primary source for heat extraction and rejection for the district system. The advantages to the building owner include: (1) hot water and chilled water can be purchased at a rate comparable or below that of operating their own boiler and chiller; (2) the need for a boiler and chiller are eliminated which substantially reduces capital cost of equipment and on-going maintenance costs; (3) the elimination of related costs such as water treatment, insurance and maintenance labor; (4) the gain of space in the building which would be occupied by the equipment could be utilized for alternative purposes.

37156 **(KC—86/01d) Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell.** Berggreen Petersen, M.; Jansen, P. (Korrosionscentralen, Broendby (Denmark)). Jul 1986. 101p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752366.

This report includes the results of the Danish part of the nordic project on internal corrosion in heat distribution systems. The development of a cell to monitor the corrosivity of the circulating water has been the aim of this part of the project. The controlling factors in the development of corrosion on the water side of heating systems are treated, and remedial measures are discussed. Special attention is paid to the initiation and propagation of crevice corrosion, and a model cell with a crevice forming element has been designed. The response of the model cell on oxygen content and conductivity has been investigated in the laboratory. Corrosion currents has been measured in the range form 10 nA/cm/sup 2/ to 50 uA/cm/sup 2/ depending of the oxygen content, the conductivity and the temperature. The current from the cell is limited by the ohmic potential drop in the electrolyte in the cell. The investigations have confirmed the importance of an adequate treatment of the circulating water and the feed water, since all oxygen which enters a heating system is causing corrosion. The results of a field test of the corrosion cell in the district heating systems in Aalborg and in Herning is included in the report.

37157 **(PB—87-179297/XAB) Real-time monitoring of a hazardous-waste incinerator with a mobile laboratory. Report for December 1986-January 1987.** Nolen, S.L.; Ryan, J.V.; Bridge, R. (Acurex Corp., Research Triangle Park, NC (USA)). Apr 1987. 16p. NTIS, PC A02/MF A01.

This paper discusses an EPA project involving a mobile laboratory for continuous monitoring of emissions and operating parameters of hazardous-waste incinerators. This Hazardous Air Pollutants Mobile Laboratory (HAPML), easily transported for use by research projects at a variety of incinerators, provides an integrated sampling and analytical package for evaluation and development of continuous and semi-continuous monitors for hazardous-waste incinerators. The HAPML recently participated in a field test to examine the total mass emissions from an incinerator during steady-state and transient conditions. The HAPML acquired continuous

emission-monitoring data and on-line gas chromatograph/flame ionization detector (GC/FID) hydrocarbon data. The paper discusses the development of the HAPML, its capabilities, data obtained while monitoring a hazardous-waste incinerator, and future plans.

37158 **(PB—87-182614/XAB) Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987.** Dykes, R.M.; Barnett, K.W.; Palazzolo, M.A.; Bostian, H.E. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 11p. NTIS, PC A02/MF A01.

Emissions testing is to be conducted on four municipal-sludge incinerators over longer periods of time than normal. Three multiple hearths and one fluid-bed are to be included, and testing is scheduled during April, May, and June 1987. Measurements are planned over the short term under smooth-compliance testing-type conditions and over longer times in order to include typical varying conditions. Variations that might be encountered include startup, shutdown, temperature excursions, feed-rate changes, and downtime during maintenance on part of the dewatering system. Metals and organics are both of interest, including products of incomplete combustion. Closing of material balances is desired where possible. The comparisons between short-term and long-term operation could point the way to more realistic testing and regulating of sludge incineration in the future.

37159 **Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling.** Karvelas, D.; Kaminsky, J.; Peters, E. (Argonne National Lab., Argonne, IL 60439). pp 241-250 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

District heating and cooling (DHC) is a method by which thermal energy from a central source is distributed to residential, commercial, and industrial consumers for use in space heating, cooling, water heating, and process heating. The central source may be one of any number of options best suited for a DHC system, such as boiler units, a refuse incinerator, a geothermal source, solar energy, or one that utilizes heat developed as a by-product of electrical generation. Low-temperature energy sources represent a large potential energy source for DHC systems; such sources include lakes, groundwater aquifiers, flooded mines, sewage ponds, and power plant cooling systems and stack heat. Many such sources are located close to high-energy-use areas and could be easily utilized as low-cost energy sources for future DHC projects. Before these low-temperature energy sources can be fully utilized in DHC systems, however, cost-effective heat extraction technologies must be developed and the economic viability of their use demonstrated.

# 33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

## 3301 Internal Combustion Engines

*REFER ALSO TO CITATION(S) 36605, 36749, 37168, 37169, 37170, 37171, 37172, 37173, 37174, 37175, 37176, 37177, 37178, 37179, 37181, 37182, 38003*

37160 **(CONF-870210—1) Testing of developmental ceramic materials in diesel engine combustion chambers.** Graves, R.L.; Kahl, W.K.; Long, E.L. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02. File Number DE87004259.

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

The development of the "adiabatic" (i.e., low-heat-rejection) diesel is unique in that it affords opportunities to improve the fuel efficiency of transportation power plants and to utilize lower-quality fuels as well. Achievement of the adiabatic diesel involves the use of high-temperature-resistant, thermally insulating materials in the construction of the combustion chamber. These materials, in the form of coatings or monolithic components, may have to operate at nominal surface temperatures of 1000°C. Promising new materials, several under development at ORNL, have not yet been subjected to dynamic engine conditions to aid in determining their feasibility for combustion chamber applications. A testing project at ORNL is seeking to fill in the information gap between materials development in the laboratory and full-fledged component development. An initial set of simply configured ceramic samples were tested in a single-cylinder 0.825-liter diesel engine. The composite ceramic samples were all made from the same material, composed of an alumina ($Al_2O_3$) matrix with silicon carbide (SiC) whiskers. A sample of partially stabilized zirconia (PSZ) was also tested to provide a monolithic material baseline. The samples were mechanically held inside the prechamber of this indirect-injection diesel in a position and configuration resembling the normal glow-plug. They were subjected to individual repetition periods of the same basic hour-long test cycle involving three load changes. Although direct measurement of internal material temperatures was not performed, thermocouple probes indicated peak ceramic bulk temperatures of ~650°C were approached. One of the samples failed catastrophically for uncertain reasons. Microscopic examination of the tested samples generally revealed no significant changes in the composite material's matrix/whisker microstructure.

37161 **(DOE/CS/50058—T1) A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report.** (COMSIS Corp., Wheaton, MD (USA)). May 1986. Contract AC01-81CS50058. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87004908.

The orientation of this case study has been toward understanding consumer acceptance of the diesel, with an emphasis on trying to explain the pronounced rise and fall in demand for diesels between 1975 and 1984. Supporting data have been compiled to illustrate and chart changes in vehicle demand during the period of study, along with information on parallel trends, such as fuel price and various economic indicators as a backdrop for studying changes in consumer attitudes. This report also presents data and discussion which chart the peak in diesel demand. It starts with a discussion of market conditions immediately preceding and accompanying the peak in demand through 1982. Trends in sales and other economic factors are described through various tables and charts. A discussion is then provided of the subsequent decline, with an explanation of the role of the various factors.

37162 **(EUR—9491) Alfa Romeo modular taxi: Demonstration project. Final report.** (Commission of the European Communities, Luxembourg). 1985. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752300.

The aim of the project was to demonstrate the effective fuel savings possible in urban traffic (at low power) using a 'modular' engine for a fleet of taxis. The modular engine consists of a traditional Otto-engine equipped with electronic fuel injection and ignition, monitored by a micro-processor supporting a specific algorithm allowing the use of only two cylinders, when the power required is below a given value. When this occurs the injection of fuel into two cylinders is interrupted. The inactive cylinders are not always the same, being chosen in order to maintain the engine at a steady temperature. The results of the project also showed that the modular engine used in urban traffic allowed a reduction in fuel consumption amounting to 12% compared with a car already equipped with electronic fuel injection and ignition. Such a saving is in addition to a similar reduction in consumption by cars equipped with an electronically controlled engine compared with similar cars equipped with a carburettor. The reduction in consumption of a 'modular' car compared with a corresponding car with a carburettor can thus be estimated at around 24%. It must be emphasized that this reduction can be obtained without reducing the maximum power output of the car's engine.

37163 **(NP—7752456) Automobile engines. Design and function.** Huetten, H. (Opel (A.) A.G., Ruesselsheim (Germany, F.R.)). Jan 1986. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752456.

A copiously illustrated overview of different types of vehicle engines, their structure and the way they work, as well as the advantages and snags of each as a means of propulsion, is given. De-

tails are given of combustion processes, the way output is generated in a four-stroke internal combustion system and the diesel process, and the number and arrangement of the cylinders. Data is also given on the engine components cylinder block, crank operation, intake and outlet system, and valves and controls, carburettor and fuel injection system. The ignition system, cooling system and lubrication are presented. Special features of the diesel engine, its fuel injection controls and combustion are pointed out. In conclusion, the rotary piston engine and engine supercharging are dealt with, and successful attempts at exhaust detoxification are mentioned. It seems likely that the internal combustion engine will remain the means of propulsion for our vehicles for some time to come. (HWJ).

37164 **(NP—7770107) Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation.** Erdmann, H.-D. (Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik). Jun 1984. 177p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770107.

Theoretical and experimental studies were carried out to determine the influence of the mixture formation process on the combustion process of a diesel engine. The main interest was to gain knowledge as to whether manufacturing tolerances in the fuel injection system of a diesel car engine caused significant change in the functioning of the fuel injection system and whether engine operating data could thus be influenced. A detailed description is given of the measuring set-ups and experimental methods used in the study, computer programmes for the moving simulation of diesel fuel injection systems, the evaluation and assessment of injection and combustion pressure processes, theoretical preliminary studies on the influence of manufacturing tolerances on the fuel injection process, the tolerances found on the basis of measurements for the major influence factors and the influences of the most important parameter tolerances on the fuel injection process and engine operation. In conclusion, consequences are drawn from the results of the study. These include new design bases for some manufacturing tolerances and improved testing methods. (HWJ).

37165 **(NP—7770108) Studies on engine output control for internal combustion engines.** Kreuter, P. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 6 Apr 1983. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770108.

In internal combustion engines, the unsolved problem still exists of the negative influence of throttle control on engine performance with regard to fuel consumption and exhaust emissions. This is the reason why the objective of this study was to analyse various processes for improving the performance of internal combustion engines on the basis of their effectiveness. Parameters which can influence power output control include: fuel value of fuel, stochiometric fuel/air ratio, density of mixture, cylinder capacity, volumetric efficiency (mixture mass after gas exchange), number of cylinders, revs, stroke ratio and efficiency. A system of this type was developed systematically according to the definition of the requirements to be demanded of a power control. Details of the study programme are given and valve drives with variable valve control times are presented. The results of the study state gas exchange losses, power control processes, influence of the high pressure process, evaluation of an engine characteristic diagram point, load performance, rev performance, engine characteristic diagram and cylinder process. (HWJ).

37166 **Super gripper variable vane arm.** Ludwick, G.E. (to Secretary of the Air Force, Washington, DC). US Patent 4,668,165. 26 May 1987. Filed date 27 Mar 1986. vp.

This patent describes in combination with a turbine engine, a variable vane assembly comprising: a vane system which may be rotated. The vane stem has a tip with first and second parallel slots on opposite sides of it spaced below the vane stem's tip. The vane stem has an end slot in the tip, the end slot, being perpendicular to the first and second parallel slots; and a vane arm which integrally fits on the tip of the vane stem without threaded fasteners, the vane arm thereby being capable of being rotated by the vane stem within the turbine engine. The vane arm comprises a flat wide metal strip with two ears near one end, the ears being outer edges of the metal strip which are turned outwards to engage the first and second parallel slots in the vane stem. The metal strip also has a central leaf which turns downwards between the two ears to engage the end slot in the tip of the vane stem. The central leaf thereby serves as an axial retainer as the vane stem rotates the vane arm.

37167 **Performance of ceramics in ring/cylinder applications.** Dufrane, K.F.; Glaeser, W.A. Warrendale, PA; Society of Automotive Engineers (1987). 7p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

In support of the efforts to apply ceramics to advanced heat engines, a study is being performed of the performance of ceramics at the ring/cylinder interface of advanced (low heat rejection) engines. The objective of the study, managed by the Oak Ridge National Laboratory, is to understand the basic mechanisms controlling the wear of ceramics and thereby identify means for applying ceramics effectively. Attempts to operate three different zirconias, silicon carbide, silicon nitride, and plasma-sprayed ceramic coatings without lubrication have not been successful because of excessive friction and high wear rates. Silicon carbide and silicon nitride perform well at ambient temperatures with fully formulated mineral oil lubrication, but are limited to temperatures of 500F because of the lack of suitable liquid lubricants for higher temperatures.

## 3303 Electric-powered Systems

*REFER ALSO TO CITATION(S) 36946, 36947*

## 3307 Emission Control

*REFER ALSO TO CITATION(S) 37635, 37654, 38003*

37168 **(PB—87-141602/XAB) Application for certification 1987 model year heavy-duty engines.** (Environmental Protection Agency, Washington, DC (USA)). 1986. 690p. NTIS, PC PC E99/MF E99.

Set includes PB—87-141610 through PB—87-141644.

37169 **(PB—87-141610/XAB) Application for certification 1987 model year heavy-duty engines - Caterpillar.** (Caterpillar Tractor Co., Peoria, IL (USA)). 1987. 290p. NTIS PC$38.50/MF$16.50.

See also PB—86-176211, and PB—87-141636; Also available in set of 4 reports PC E99, PB—87-141602.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37170 **(PB—87-141628/XAB) Application for certification 1987 model year heavy-duty engines - Chrysler.** (Chrysler Corp., Detroit, MI (USA)). 1987. 213p. NTIS PC$32.50/MF$16.50.

See also PB—84-124551, PB—87-141610, and PB—87-141636; Also available in set of 4 reports PC E99, PB—87-141602.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends

to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37171 **(PB—87-141636/XAB) Application for certification 1987 model year heavy-duty engines - Mitsubishi Motors corporation.** (Mitsubishi Motors Corp., Tokyo (Japan)). 1987. 93p. NTIS PC$22.50/MF$16.50.

See also PB—86-176260, PB—87-141628, and PB—87-141644; Also available in set of 4 reports PC E99, PB—87-141602.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37172 **(PB—87-141651/XAB) Application for certification 1987 model year light-duty vehicles.** (Environmental Protection Agency, Washington, DC (USA)). 1987. 20,698p. NTIS, PC PC E99/MF E99.

Set includes PB—87-141669 through PB—87-141792.

37173 **(PB—87-141677/XAB) Application for certification 1987 model year light-duty vehicles - Chrysler.** (Chrysler Corp., Detroit, MI (USA)). 1987. 3645p. NTIS PC$317.00/MF$27.50.

See also PB—85-136539, PB—87-141669, and PB—87-141685; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37174 **(PB—87-141685/XAB) Application for certification 1987 model year light-duty vehicles and light-duty trucks - Ford Motor Company.** (Ford Motor Co., Dearborn, MI (USA)). 1987. 2676p. NTIS PC$239.50/MF$24.00.

See also PB—86-176187, PB—87-141677, and PB—87-141693; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provided information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37175 **(PB—87-141693/XAB) Application for certification 1987 model year light-duty vehicles - General Motors.** (General Motors Proving Ground, Milford, MI (USA)). 1987. 2817p. NTIS PC$250.50/MF$40.00.

See also PB—85-136547, PB—87-141685, and PB—87-141701; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37176 **(PB—87-141735/XAB) Application for certification 1987 model year light-duty vehicles - Mercedes-Benz.** (Mercedes-Benz of North America, Inc., Montvale, NJ). 1987. 758p. NTIS PC$76.00/MF$17.00.

See also PB—86-176195, PB—87-141727, and PB—87-141743; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37177 **(PB—87-141743/XAB) Application for certification 1987 model year light-duty vehicles - Nissan.** (Nissan Motor Co. Ltd., Yokohama (Japan)). 1987. 2437p. NTIS PC$215.00/MF$23.50.

See also PB—86-135886, PB—87-141735, and PB—87-141750; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37178 **(PB—87-141768/XAB) Application for certification 1987 model year light-duty vehicles - American Motors Corporation (Renault).** (American Motors Corp., Detroit, MI). 1987. 1182p. NTIS PC$110.00/MF$19.00.

See also PB—86-135894, PB—87-141750, and PB—87-141776; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37179 **(PB—87-141776/XAB) Application for certification 1987 model year light-duty vehicles - Rolls Royce.** (Rolls Royce Motors, Inc., Lyndhurst, NJ (USA)). 1987. 300p. NTIS PC$39.00/MF$16.50.

See also PB—86-135902, PB—87-141768, and PB—87-141784; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37180 **(PB—87-141792/XAB) Application for certification 1987 model year light-duty vehicles - Volkswagen.** (Volkswagen of America, Inc., Ann Arbor, MI). 1987. 3455p. NTIS PC$301.50/MF$35.50.

See also PB—86-135910, and PB—87-141784; Also available in set of 14 reports PC E99, PB—87-141651.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. The engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37181 **(PB—87-172342/XAB) Application for certification 1987 model year light-duty vehicles.** (Environmental Protection Agency, Washington, DC (USA)). 1987. 1088p. NTIS, PC PC E99/MF E99.

Set includes PB—87-172359, and PB—87-172367. See also PB—87-141651.

37182 **(PB—87-172359/XAB) Application for certification 1987 model year light-duty vehicles - Isuzu.** (Isuzu Motors America, Inc., Southfield, MI). 1987. 811p. NTIS PC$80.00/MF$17.50.

See also PB—87-172367 and PB—86-135845; Also available in set of 2 reports PC E99/MF E99, PB—87-172342.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. They also provide information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

37183 **(PB—87-185724/XAB) Passenger-car emissions in the speed range 80-120 kmph. Traffic measurements on a fleet of cars in the Pfaender Road Tunnel.** Lindner, R.; Mueller, W.; Babelot, J.F.; Glatz, J.P.; Geiss, F. (Commission of the European Communities, Luxembourg). 1985. 39p. (In German). (EUR—10044-DE). NTIS, PC PC E03/MF E03.

Customers in the European Community countries should apply to the Office for Official Publications of the European Communities, B.P. 2985, Luxembourg.

A fleet of 70 private cars, chosen to be representative as to cylinder capacity, state of maintenance, and age distribution, were measured under traffic conditions for NOx, $SO_2$ and hydrocarbon emissions. The experimental setup: In the night from 2nd to 3rd November 1984 the Pfander road tunnel, which has been closed for traffic, was driven through at varying speeds, and the entire emissions were measured in both waste-air shafts under careful setting of the ventilation conditions. The entire volume of harmful substances released was calculated from concentration and air throughput volume. This experiment fills a gap in the insight into and the methodological approach to the solving of similar problems, as published information was hitherto mostly gained from calculations supported by rolling bench tests, with the authors regretting that tests on the road seemed to be a technical impossibility, for the time being.

37184 **(PB—87-190567/XAB) User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986.** Bullin, J.A.; Korpics, J.J.; Hlavinka, M.W. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1986. 223p. (TTI—2-8-80-283-2). NTIS, PC A10/MF A01.

The original TEXIN model, which was previously developed to predict carbon monoxide concentrations near simple intersections, had several restrictions that inhibited its use in many realistic cases. The model was expanded to include modeling capabilities of four-way-stop intersections. The CMA Operations and Design Procedure traffic algorithm was added to allow for more-accurate representation of T-intersections. The addition of the EPA emissions model, MOBILE3, enables the user to more accurately estimate source strength. The new calculational methodologies and algorithms present in MOBILE3, including vehicle anti-tampering and inspection/maintenance programs, greatly enhance the capabilities of the model. The TEXIN2 model employs a short-cut emissions algorithm for users who do not wish to use MOBILE3. The report is intended to assist the analyst in the execution of the TEXIN2 model. A brief description of the model is first given. Next, the input data required by the model are presented. Finally, several illustrative examples are presented.

## 3308 Alternative Fuels

*REFER ALSO TO CITATION(S) 36605*

# 35 ARMS CONTROL

*REFER ALSO TO CITATION(S) 37492*

37185 **(AD-A—179163/1/XAB) Air Force Technical Objectives Document, Fiscal Year 1988. Annual report, January 1986-January 1987.** (Air Force Human Systems Div., Brooks AFB, TX (USA)). Jan 1987. 27p. (HSD-TR—87-005). NTIS, PC A03/MF A01.

This Technical Objective Document (TOD) describes the planning methodology used within two of HSD's laboratories to achieve their technical goals. Specifically, efforts are directed in the biotechnology program to man's adaptability, survivability, and performance capabilities within his operational environment. This research and development of HSD's functions is accomplished as interdisciplinary work by teams of biomedical scientists, engineers, and physical scientists within the Air Force laboratories and the industrical and academic communities.

37186 **(AD-A—179298/5/XAB) Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report.** Linn, C.J.; Linn, J.L.; Kappel, M.R.; Salasin, J. (Institute for Defense Analyses, Alexandria, VA (USA)). 16 Mar 1987. 52p. (IDA-P—1983). NTIS, PC A04/MF A01.

This paper presents the first revision of the SDI Ada Process Description Language (SA/PDL). SA/PDL provides a uniform notation for the description of SDI system architectures and Battle Management and Command, Control, and Communications (BM/C3) architectures. SA/PDL is not a replacement for the numerous other methods of describing the architectures that have been used in past studies, but is an additional means of description. Such a uniform formal description is needed to facilitate (1) the evaluation of comparison of architectures and development of standard tools for the analysis of architectures; (2) standardization of architectural specification for simulation purposes, and (3) development of new architectures based on preferred characteristics of architectures from previous studies. This document presents the draft SA/PDL, and the issues addressed here are only those that are relevant to providing formal descriptions of system structure and behavior both for interface consistency checking and for system simulation and evaluation.

37187 (SLAC—312, pp 687-692) **Topics in arms control.** Goldberger, M.L. (California Institute of Technology, Pasadena). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The author discusses the contributions Sid Drell has made to arms control in a speech give on the occasion of his sixtieth birthday. Among those mentioned are his service on the Jason Committee and input to the ABM treaty.

37188 **Laboratory and arms control.** *Energy and Technology Review (Livermore, CA);* 1-8(Jan-Feb 1987). Contract W-7405-ENG-48.

The purpose of arms control is to improve the security of the countries that engage in the agreements. The US and the Soviet Union as well as other independent nations have realized that additional nuclear weapons, new kinds of weapons, or expanded areas of deployment will not improve their security, and thus they are willing to negotiate limits. Michael M. May, Associate Director at Large, Paul S. Brown, Assistant Associate Director for Arms Control, Milo D. Nordyke, Leader for the Treaty Verification Research Program, and Paul L. Chrzanowski, Strategic Applications Group Leader, discuss LLNL's role in US arms control efforts. Arms control is an integral part of the Laboratory's mission. Arms control delegations often include members or advisors from LLNL to provide the technical information and make the technical arguments that stem from our expertise in weapons design.

37189 **Road to a more stable peace.** *Energy and Technology Review (Livermore, CA);* 9-11(Jan-Feb 1987). Contract W-7405-ENG-48.

In an address to the Philadelphia World Affairs Council (February 20, 1985), Paul H. Nitze, Special Advisor to the President and the Secretary of State on Arms Control Matters, discusses the Administrations' position on arms control.

37190 **Safeguarding our military space systems.** *Energy and Technology Review (Livermore, CA);* 23-30(Jan-Feb 1987). Contract W-7405-ENG-48.

The vulnerability of military space systems depends on their orbits, functions, and other characteristics. The high-altitude satellites needed for warning and communications in particular could be vulnerable to prompt destruction by certain space based systems and, in the future, possibly by ground-based high-power lasers. A combination of passive countermeasures and arms control agreements could give these satellites some protection against such attack. Deployment of strategic defensive systems with the capability to reach far into space would invalidate this approach. 3 references, 6 figures.

37191 **Transition to deterrence based on strategic defense.** *Energy and Technology Review (Livermore, CA);* 31-45(Jan-Feb 1987). Contract W-7405-ENG-48.

A methodology is presented to investigate the transition from the present world, dominated by strategic balance of offensive weapons, to a future in which we have adopted a deterrence posture that relies on strategic defense. Issues about crisis stability and strategic balance during such a transition and the impact of uncertainties in system performance are also examined. An important conclusion of the analysis is that it is important to reduce the vulnerability of offensive forces before beginning the deployment of defenses with wide-area coverage. 7 references, 11 figures.

37192 **Avoiding war with the Soviet Union.** *Energy and Technology Review (Livermore, CA);* 50-59(Jan-Feb 1987). Contract W-7405-ENG-48.

Understanding and consideration of such nontechnical issues such as culture, politics, history, and language are essential if negotiations with the Soviet Union on the technical aspects of arms control are to be successful. To address nontechnical as well as technical issues of arms control, a seminar series on avoiding war with the Soviet Union is being conducted at LLNL. The speakers come from widely different backgrounds and perspectives. Interestingly, they all have expressed several common themes. They all believe that the US and the Soviet will continue to consider nuclear weapons essential to national security. Thus, none thought that total nuclear disarmament would take place in the foreseeable future. However, every speaker believed that the nuclear deterrent will hold, and none thought that conflict between the US and the Soviet Union is imminent. 1 table.

## 3501 Policy, Negotiations, And Legislation

*REFER ALSO TO CITATION(S) 37595*

37193 **Arms control and future limits on nuclear weapons.** *Energy and Technology Review (Livermore, CA);* 46-49(Jan-Feb 1987). Contract W-7405-ENG-48.

A workshop was held at LLNL in September 1986 to examine nuclear weapon limits of the future, the possible character of these limits, and the role of arms control in negotiating these limits. Most of the speakers viewed limits on strategic arms, established by agreement, as desirable so long as the limits provide for a more stable configuration of forces. Arms control was seen by most to serve as a measure of rationality of the two sides. However, it has definite limits - arms control cannot generate improvements in US-Soviet relations. Several speakers emphasized that nuclear weapons have actually introduced a stabilizing influence into the US-Soviet relationship since the consequences of a nuclear conflict are clearly apparent. Most asserted that there would be continued reliance on nuclear deterrence; some even said that nuclear deterrence will remain stable, with or without arms control agreements. 1 table.

## 3502 Proliferation

*REFER ALSO TO CITATION(S) 37588*

## 3503 Verification

37194 **(CONF-870233—2) Arms control and treaty verification technology: Contributions from the nonweapons laboratories.** Ball, J.R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87011701.

From Annual meeting of American Association for the Advancement of Science; Chicago, IL, USA (14 Feb 1987).

This paper presents a discussion of the role that the multidisciplinary DOE nonweapons laboratories can play in future research and development of arms control and treaty verification technology. In the past, this area of R and D has largely been the domain of the weapons laboratories. However, the nonweapons laboratories have participated in selected areas of technological research in support of such agreements as the Nuclear Nonproliferation Treaty, the Limited Test Ban Treaty and the Proposed Treaty on the Prohibition of Chemical Weapons and have demonstrated their broad capabilities to contribute to the development of these technologies. It is in the national interest for funding agencies to take full advantage of the previously underutilized capabilities of the nonweapons laboratories and thereby bring "fresh" and innovative approaches to deal with future arms control and treaty verification problems. Federal agencies must be made aware of the capabilities of the nonweapons laboratories and those laboratories interested in pursuing this area of research should initiate strong program development efforts and prepare strong research proposals. The US's and the international community's goals for arms control and disarmament treaties can best be met by the combined efforts of the weapons and nonweapons research laboratories.

37195 **Arms control activities in LLNL.** *Energy and Technology Review (Livermore, CA);* 12-22(Jan-Feb 1987). Contract W-7405-ENG-48.

The Laboratory's involvement in US arms control efforts is concentrated on the technical issues of verification and the technical aspects of various arms control proposals and issues. LLNL makes major contributions to the arms control process in four areas, assessing national security requirements with respect to nuclear weapons and the impact of potential treaty provisions, developing technology in support of treaty verification. assessing weapons-related foreign technology, and studying the problem of nuclear proliferation. 2 figures, 1 table.

# 36 MATERIALS

37196 **(LBL—23442) Enthusiasms and realities in advanced materials.** Gilman, J.J. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 18p. (CONF-8704157—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010976.

From T. A. Read memorial lecture; Urbana, IL, USA (15 Apr 1987).

This paper offers general comments on the past, present, and future of materials technology. The process by which a substance becomes an engineering material is lengthy. The following functional areas are likely to grow most in the foreseeable future: photonics, robotics, prosthetics, astronautics, and nanoelectronics. The trend in advanced materials is toward integration. (DLC)

37197 **(UCID—20622-87-2) Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87.** (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011547.

The progress report has been divided into broad categories that reflect research areas of current emphasis in the department: Advanced Materials; Materials Characterization and Analysis; Physical Metallurgy; Chemical Reactions and Transport Processes; and Properties of Hydrogen Isotopes.

## 3601 Metals And Alloys

*REFER ALSO TO CITATION(S) 36232, 36240, 36351, 36352, 36458, 36463, 36755, 36775, 36775, 36778, 36783, 36801, 36801, 36802, 36804, 36831, 37152, 37156, 37325, 37510, 37634, 38303, 38388, 38388, 38388*

37198 **(AD-A—179245/6/XAB) Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Annual technical report, November 1985-January 1986.** Perkins, R.A.; Chiang, K.T.; Meier, G.H. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div.). 20 Feb 1987. 84p. (LMSC/F—195926). NTIS, PC A05/MF A01.

A model derived from first principles for the transition from internal to external oxidation was shown to be applicable to the oxidation of alloys. The feasibility of forming protective alumina scales by the selective oxidation of aluminum at greatly reduced Al contents was demonstrated. The critical NAL for the transition was lowered to between 25 and 30 at.% AL by the balanced addition of elements that simultaneously reduce NO(s) and DO and increase DAL in the alloy. The model indicates that a low DAL is the major factor limiting the selective oxidation of Al and that an increase of about 6 orders of magnitude would be required to effect a transition to external scale information at 1100 C. A major increase in DAL was achieved by adding Ti to increase the solubility of Al in bcc Nb. This resulted in formation of alumina at an NAL of 0.4 in air at 1400 C. By adding Cr and V to reduce NO(s) and DO, the critical NAL was reduced further to between 0.25 and 0.3 at 1400 C. An alloy of niobium-29 titanium-38 aluminum-3 chromium-4 vanadium (at.%) formed highly protective alumina in air at 1400 C. The ability to form alumina decreased as temperature decreased due to the high activation energy of alumina formation and rapid kinetics of transient oxidation. Further modification of both composition and alloy structure is needed.

37199 **(AD-A—179264/7/XAB) Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987.** Giovanola, J.H.; Shockey, D.A. (SRI International, Menlo Park, CA (USA)). 27 Feb 1987. 21p. NTIS, PC A02/MF A01.

The optimal use of advanced beta and near-beta titanium alloys, in situations involving dynamic or shock loading, requires an understanding of how both microstructure and loading rate influence the fracture behavior. To address this need, SRI is performing dynamic crack initiation and propagation experiments on Ti-10V-2Fe-3A1 in three microstructural conditions, varying the loading rate to establish the rate-dependence of the fractire toughness. A new experimental method, developed in a previous Air Force Office of Scientific Research program (the one-point-bend impact test) and advanced instrumentation techniques (optical and Hall effect displacement transducors) are used to measure the dynamic initiation and propagation toughness. The Fracture Surface Topography Analysis (FRASTS) technique, a novel quantitative fractography technique, is applied to the fractured specimens to elucidate the microstructural failure mechanisms contolling fracture in each of the investigated microstructures. This report summarizes the progress made during the first year of the program. A metallurgical investigation was completed to determine the appropriate heat treatments to produce three microstructures with 0%, 12%, and 40% of primary alpha phase, and with a strength level of about 1300 MPa. An optical technique to measure crack-opening displacements (COD) during dynamic fracture experiments was developed. Numerical algorithms were implemented in SRI's finite-element computer codes to compute the stress-intensity factor in simulations of the dynamic-fracture experiments.

**37200 (AD-A—179289/4/XAB) High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987.** Persad, C.; Marcus, H.L.; Weldon, W.F. (Texas Univ., Austin (USA). Center for Materials Science and Engineering). 31 Mar 1987. 127p. (UT-CMSE—87-02). NTIS, PC A07/MF A01.

This exploratory research program was initiated to investigate the potential of using pulse power sources for powder consolidation, deposition and other high-energy high-rate processing. The characteristics of the high-energy-high-rate (1MJ/s) powder consolidation using megampere current pulses from a homopolar generator, were defined. Molybdenum Alloy TZM, a nickel-based metallic glass, copper/graphite composites, and P/M aluminum alloy X7091 were investigated. The powder-consolidation process produced high densification rates. Density values of 80% to 99% could be obtained with subsecond high-temperature exposure. Specific energy input and applied pressure were controlling process parameters. Time temperature transformation (TTT) concepts underpin a fundamental understanding of pulsed power processing. Inherent control of energy input, and time-to-peak processing temperature developed to be held to short times. Deposition experiments were conducted using an exploding-foil device (EFD) providing an armature feed to railgun mounted in a vacuum chamber. The material to be deposited - in plasma, gas, liquid, or solid state - was accelerated electromagnetically in the railgun and deposited on a substrate. Deposits of a wide variety of single- and multi-specie materials were produced on several types of substrates. In a series of ancillary experiments, pulsed-skin-effect heating and self quenching of metallic conductors was discovered to be a new means of surface modification by high-energy high-rate-processing.

**37201 (AD-A—179606/9/XAB) Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987.** Mazumder, J.; Singh, J.; Raja, S. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Jan 1987. 41p. NTIS, PC A03/MF A01.

The present status of laser cladding of magnesium and niobium is surveyed. The potential of cladding zirconium onto magnesium and titanium onto niobium for improving environmental resistance have been discussed. In the present project, zironium was cladded onto magnesium by the preplaced powder cladding technique. The laser beam encounters the powder first placed on the substrate. A very thin layer on the top of the substrate melts and results in a cladding of minimum dilution. Corrosion properties of the Zr-clad region was evaluated in a 3.5% NaCl solution at room temperature. Substantial improvement in corrosion resistance was observed. The structural characterization of the clad region was done by optical and electron microscopy. EDAS analysis was done to identify the phases observed in electron microscopy.

**37202 (BMU—1986-111) Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2).** Schroeder-Obst, D.; Kuppler, D. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Sep 1986. 207p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-06946.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

This part 2 of the Fifth Technical Report presents information characterising the melts and heat treatment conditions valid within the framework of VdTUeV codes, as well as extreme conditions (e.g. limit-exceeding melt composition, heat treatment not complying with valid VdTUeV codes), and HAZ - simulating heat treatment conditions of the reactor structural steels 22 NiMoCr 3 7, 20 MnMoNi 5 5, 17 MnMoV 6 4, 15 NiCuMoNb 5, St E 51, 15 MnNi 6 3, 15 MnMoNiV 5 3, 14 MnNiMo 6 5 and 13 CrMo 4 4 by means of their metallographic structural parameters, their microstructural paramters, the pertinent mechanical-technological parameters, and, for some steels, by means of their fracture mechanics parameters. In addition, interdependencies between microstructural parameters and the metallographic structural parameters are shown and explained, as well as those between mechanical-technological and fracture mechanics parameters. (orig./IHOE).

**37203 (CONF-861076—7) The ceffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr.** King, W.E.; Grabowski, K.S.; Baldo, P.M. (Argonne National Lab., IL (USA); Naval Research Lab., Washington, DC (USA)). Mar 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011357.

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

We have investigated the effect of Y ion implantation on the high temperature oxidation of Fe-24Cr using Rutherford backscattering spectroscopy and analytical electron microscopy. Results indicate that implantation of Y has a very large effect on the growth rate of the oxide compared to metals alloyed with Y. Analytical tools have been applied to determine the spatial distribution of Y and the microstructure of the oxide. Results are compared with those of recent cation grain boundary diffusion measurements in $Cr_2O_3$ and $Cr_2O_3$ doped with $Y_2O_3$.

**37204 (CONF-870142—13) Understanding photoemission spectra in uranium based heavy fermion systems.** Arko, A.J.; Yates, B.W.; Dunlap, B.D.; Koelling, D.D.; Mitchell, A.W.; Lam, D.J.; Olson, C.G.; del Guidice, M.; Fisk, Z.; Smith, J.L. (Argonne National Lab., IL (USA); Ames Lab., IA (USA); Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science; Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-31109-ENG-38;W-7405-ENG-36;W-7405-ENG-82. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011476.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

In 4f compounds, there is a two-peaked structure associated with 4f photoemission spectroscopy, while most 5f compounds yield a single broad triangular-shaped 5f intensity. Evidence is presented from measurements on ternary alloys that show that at least part of the extra-5f intensity is due to the hitherto missing main peak (or d-screened f-hole peak) just as in the 4f systems. The remaining intensity is consistent with a band structure DOS. (The compounds used were URh3B/sub x/, UPd/sub x/Rh/sub 3-x/, $ThBe_{13}$, $UIr_3$, and $UBe_{13}$.) (DLC)

**37205 (CONF-870142—14) The Fermi surface of CeSb.** Crabtree, G.W.; Aoki, H.; Joss, W.; Hulliger, F. (Argonne National Lab., IL (USA); National Research Inst. for Metals, Tokyo (Japan); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Basses Temperatures; Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011483.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

This paper uses accurate Fermi surface measurements as a test of hybridization models in CeSb. Detailed measurements of the Fermi surface geometry and effective masses are presented which show a number of unusual properties associated with the magnetic structure and anisotropy. Measurements are compared with predictions of a band structure in which the f-electron is assumed to be local, interacting with the conduction electrons only through anisotropic Coulomb and exchange interactions. This model reproduces all the unusual features observed in the measurements and suggests that hybridization is not essential to describing the electronic properties of CeSb.

**37206 (CONF-870142—15) f-band narrowing in uranium intermetallics.** Dunlap, B.D.; Litterst, F.J.; Malik, S.K.; Kierstead, H.A.; Crabtree, G.W.; Kwok, W.; Lam, D.J.; Mitchell, A.W. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011487.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

Although the discovery of heavy fermion behavior in uranium compounds has attracted a great deal of attention, relatively

little work has been done which is sufficiently systematic to allow an assessment of the relationship of such behavior to more common phenomena, such as mixed valence, narrow-band effects, etc. In this paper we report bulk property measurements for a number of alloys which form a part of such a systematic study. The approach has been to take relatively simple and well-understood materials and alter their behavior by alloying to produce heavy fermion or Kondo behavior in a controlled way.

37207 **(CONF-870178—1) Kinetic theory of radiation effects.** Mansur, L.K. (Oak Ridge National Lab., TN (USA)). 21 Jan 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87008775.

From Workshop on supercomputer utilization in radiation effects modeling; San Diego, CA, USA (21 Jan 1987).

To help achieve the quantitative and mechanistic understanding of these processes, the kinetic theory of radiation effects has been developed in the DOE basic energy sciences radiation effects and fusion reactor materials programs, as well as in corresponding efforts in other countries. This discipline grapples with a very wide range of phenomena and draws on numerous sub-fields of theory such as defect physics, diffusion, elasticity, chemical reaction rates, phase transformations and thermodynamics. The theory is cast in a mathematical framework of continuum dynamics. Issues particularly relevant to the present inquiry can be viewed from the standpoints of applications of the theory and areas requiring further progress.

37208 **(CONF-870314—11) An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications.** Natesan, K.; Miller, S.A.; Podolski, W.F. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011515.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

The major materials issue in the commercialization of fluidized-bed combustion (FBC) systems for utility cogeneration applications is the corrosion/erosion degradation of in-bed components. To examine this issue, pertinent materials information was collected from 13 sources that included 16 different experimental fluidized-bed combustors (four pressurized, the other atmospheric), and a detailed analysis of the data was performed. The data analysis confirmed that austenitic stainless steels (notably Types 304 and 310) and cobalt-base alloys (notably Haynes 188) are superior to nickel-base alloys. Type 347 stainless steel and Incoloy 800H are questionable from the point of view of metal wastage. Very limited data are available for claddings and coatings. The correlations of the corrosion rate data presented in this paper for several of the more promising alloy candidates for air heater application provide guidelines for the selection of materials with reasonably assured performance in a corrosive environment.

37209 **(CONF-870388—11) Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments.** Natesan, K.; Johnson, R.N. (Argonne National Lab., IL (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1987. Contract W-31109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011496.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

Oxidation of metallic materials at elevated temperatures in bioxidant environments is a potential problem in many systems within the chemical, petroleum, and power-generating industries. The use of appropriate corrosion-resistant coatings on metallic components offers an avenue to minimize the material degradation and to extend the life of the component. The present paper discusses results obtained on the performance of chromium carbide and chromium coatings on a Type 310 stainless steel (SS) substrate exposed to oxidizing and sulfidizing gas mixtures. The coatings were developed by an electro-spark deposition (ESD) process in which duration, high-current electrical pulses were used to deposit the electrode material on the metallic substrate. This paper presents thermogravimetric test data, observations on the morphology of coating layers, and hardness depth profiles for coated and uncoated specimens after exposure to several gas mixtures at test temperatures of 875 and 650°C.

37210 **(CONF-870862—3) Application of analytical electron microscopy to design of creep resistant advanced austenitic stainless steels.** Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003456.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

AEM has been used to study fine particles (<10 nm in diam) on extraction replicas using high brightness electron sources like the field emission gun (FEG). These studies allowed alloy compositional modifications to be selected that produced stable, fine precipitates for creep strength. The creep resistance of advanced modified 14Cr-16Ni austenitics is greatly improved relative to type 316, alloy 800H or 17-14 CuMo at 700°C and a high stress of 170 MPa. AEM observations suggest that precipitates are primarily responsible for the improved creep strength.

37211 **(CONF-870862—5) Diffraction effects from interfaces.** Vitek, J.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87008797.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Diffraction effects in the L direction have been considered by several authors. In this paper, the procedures used and results obtained in such calculations are briefly reviewed. Potential applications of these calculations in gaining information on the structure of interfaces are examined. Finally, limitations and areas needing further work are discussed.

37212 **(CONF-870873—2) The influence of N-ion irradiation on superconducting TiN.** Thompson, J.R.; Ellis, J.T.; Christen, D.K.; Sekula, S.T.; Lewis, J.D.; Williams, J.M. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). May 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. File Number DE87009822.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The influence of disorder on the properties of the B1 phase superconductive compound titanium nitride has been investigated. Following synthesis and characterization of thin films of TiN, the materials were disordered progressively and uniformly by irradiation with nitrogen ions. The superconducting transition temperature T/sub c/ decreased and the low temperature electrical resistivity rho increased as lattice damage was introduced. The dependence of both T/sub c/ and rho on N-ion fluence phi could be described by exponentially saturating functions of phi with similar rate constants. These constants correspond to characteristic damage energy densities of 14 and 12 eV/atom, respectively.

37213 (CONF-8506355—, pp 20.1-20.17) **Inductive heating - influence on surface standard, microstructure and ductility.** Andersson, H. (MEFOS, Luleaa, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

In order to investigate how inductive heating affects surfaces and internal structure and what influence the fast inductive heating lapse has on the hot-workability, heating and rolling experiments have been performed on unalloyed, low alloyed and high alloyed steels. The experiments showed that: Plain constructional steels, austenitic stainless steels and duplex ferritic-austenitic stainless steels with low ferrite content can be heated up rapidly from ambient temperature while crack sensitive steels demand a reduced heating rate until their centre temperature exceeds approximately 250 - 300 degree C. Heating in an inductive heater causes less scale than heating in a conventional fuel fired furnace. Expected phase transformations do not take place in high alloyed steels if the material is not held at high temperatures an adequate time. Insufficient equalizing of temperature gradients and insufficient dissolving of large carbides increase the risk for surface cracking in the hot rolling operation.

37214 (CONF-8506355—, pp 22.1-22.18) **Oxide scale formation on steel in fuel fired reheating furnaces.** Jarl, M.; Leden, B. (MEFOS, Luleaa, Sweden). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Oxide scale formation on steel in reheating furnaces results in a lower yield of metal. Oxidation rate has been measured and discussed in many papers. It has often been described by a parabolic model. However, oxidation rate in a reheating furnace is not easy to predict. In this study a combination of a parabolic and a linear model has been applied. This type of model approximately describes two step in the scale formation, viz diffusion of oxygen gas through a boundary gas-layer to the oxide and diffusion of metal through the oxide layer. Experiments were carried out in the fuel fired chamber furnace at MEFOS, Metal Working Research Plant (BTF) in Luleaa, Sweden. Test bars of carbon steels and low-alloy steels with a diameter of 25 mm and a length of 300 mm were heated in atmospheres form propane and heavy oil with oxygen contents between 0.3 and 6 vol percent for times between 15 and 180 minute at temperatures of 900, 1100 and 1200 degree C. The model has been for evaluation of the experimental work. The results showed that the model could well describe the oxidation of the steels in the chamber furnace. Today the model is used to on-line calculate the amount of formed oxide scale in the walking beam furnace of the rail rolling mill at SSAB, Domnarvet. The model has also been implemented in the finite-difference program STEELTEMP for temperature and heat-transfer analysis in steel plants.

37215 (CONF-8506355—, pp 23.1-23.20) **Surface quality with oxygen control of furnace atmosphere.** Petrucci, M.; Quintiliani, G.; De Vito, A.; Granato, F. (Centro Sperimentale Metallurgico, Roma-Eur, Italy; N. Italsider Taranto, Italy). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87752390.

From Scanheating: international conference on process control and energy savings in reheating furnaces; Luleaa, Sweden (12 Jun 1985).

Surface quality of steel plates strongly depends on residual scale after descaling treatment. Efficiency of descaling unit is strictly related to adhesion properties of the scale. Adhesivity of scale is influenced by oxides thickness and morphology as laboratory studies show. The way with which scale grows up depends on the operation conditions in the reheating furnaces i.e. soaking temperature, reheating time and oxygen concentration. The first two conditions are strictly related to productivity problems but oxygen amount can be set to the proper percent by a suitable regulation of air excess in the burners. For the air excess control the use of solid electrolyte oxygen cells is proper solution of the problem due to the real-time response of the apparatus. Laboratory results on scale growth were applied in Taranto reheating furnace with the aim of obtaining better surface quality of steel plates without excessive fuel consumption.

37216 (CONF-8704163—1) **Magneto-optical studies of ultra-thin epitaxial films of fcc Fe on Cu(100).** Moog, E.R.; Bader, S.D. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011420.

From International magnetics conference (INTERMAG); Tokyo, Japan (14 Apr 1987).

The surface magneto-optic Kerr effect has been used to study the magnetic properties of fcc Fe stabilized by epitaxial growth on Cu(100). The studies are performed in ultra-high vacuum with auxiliary low-energy electron diffraction and Auger electron spectroscopy characterizations of the monolayer-range films and their growth. Two states have been observed for the Fe: a metastable, ferromagnetic state for the surface layer when the Fe is grown and held at elevated temperatures, and a stable, paramagnetic state both for Fe grown near room temperature and upon cooling a ferromagnetic film. Models to explain this unusual behavior are discussed.

37217 (DOE/ER/45280—1) **X-ray scattering studies of non-equilibrium ordering processes: Progress report, August 1, 1986-October 31, 1987.** Nagler, S.E. (Florida Univ., Gainesville (USA). Dept. of Physics). Jun 1987. Contract FG05-86ER45280. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011709.

Thin films of $Cu_3Au$ have been prepared, and the kinetics of the order-disorder phase transition has been studied using time resolved x-ray scattering. We find that the symmetry of the system affects the kinetics and that the results are different than would be expected for an isotropic system with a non-conserved order parameter.

37218 (DP-MS—86-151) **Lubication and surface finish of extruded aluminum.** Thompson, A.C.; Peacock, H.B. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 6p. (CONF-861063—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010164.

From American Society of Metals materials week; Lake Buena Vista, FL, USA (6 Oct 1986).

Tests were conducted at the Savannah River Laboratory to evaluate lubricants for possible replacement of a lead powder and oil mixture. The lead mixture is currently used to lubricate billets and tooling in the extrusion of Type 8001 aluminum. Three alternative lubricants were tested. Each of these contained graphite and oil, and two had additional additives. Billets were extruded at 440°C through a conical die. The lubricating ability of each lubricant was judged by surface finish of the extruded billet and by extrusion pressure. None of the lubricants tested is a suitable replacement.

37219 (EPRI-NP—4993) **Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report.** (Velan, Inc., Montreal, Quebec (Canada); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 36p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920331.

Cobalt-free hard-facing alloys are needed in nuclear plants to help the radiation fields that are responsible for the occupational radiation exposure incurred by plant maintenance personnel. This report presents a series laboratory evaluations that were performed on the nickel-based Deloro alloys 40 and 50 to determine their suitability for use as hard-facing alloys. Wear properties, mechanical properties, corrosion resistance, and weldability were measured. Similar measurements also were obtained on a reference cobalt-based alloy. The microstructure of the nickel-based alloys following their deposition on carbon and stainless steel substrates was determined by optical microscopy.

37220 (HEDL-SA—3418) **Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59.** Simons, R.L.; Brager, H.R.; Matsumoto, W.Y. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76FF02170. 14p. (CONF-860421—75). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010412.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Nickel enriched in nickel 59 was extracted from the fragments of a fracture toughness specimen of Inconel 600 irradiated in the Engineering Test Reactor (ETR). The nickel contained 2.0% nickel 59. Three heats of austenitic steel doped with nickel-59 were prepared and inserted in the Materials Open Test Assembly (MOTA) of the Fast Flux Test Facility (FFTF). The experiment was single variable in helium effects because chemically identical alloys without nickel-59 were being irradiated side by side with the doped material. The alloys doped with nickel 59 produced 10 to 100 times more helium than the control alloys. The materials included ternary and quaternary alloys in the form of transmission electron microscope (TEM) discs and miniature tensile specimens. The helium to dpa ratio was in the range 5 to 35 and was nearly constant throughout the irradiation. The exposures ranged from 0.25 to 50 displacements per atom (dpa) over the duration of the experiment. The irradiation temperatures covered the range of 360 to 600°C.

37221 **(LA-UR—87-2134) Influence of peak pressure on the substructure evolution and mechanical properties of shock-loaded 6061-T6 aluminum.** Gray, G.T. III; Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870753—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011743.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Systematic shock recovery experiments have been performed on 6061-T6 Al shocked to pressures of 2, 8, and 13 GPa for 1 second pulse durations. Compression samples EDM machined from the recovered samples show that the mechanical behavior of 6061-T6 saturates rapidly under shock loading. Electron microscope examination reveals a random high dislocation density substructure, different from that observed in other shock-loaded aluminum alloys. Substructure evolution and mechanical response are discussed in light of the influence of strengthening mechanisms and shock recovery techniques.

37222 **(LA-UR—87-2160) Structural relaxation in Pd-Ge metallic glass.** Cost, J.R.; Stanley, J.T. (Los Alamos National Lab., NM (USA); Arizona State Univ., Tempe (USA)). 1987. Contract W-7405-ENG-36. 20p. (CONF-870893—2). NTIS, PC A02. File Number DE87011737.

From 6. international conference on rapidly quenched metals; Montreal, Canada (3 Aug 1987).

We have measured small reversible changes of electrical resistance which occur following a small temperature change applied to an amorphous $Pd_{78}Ge_{22}$ alloy. Reversibility of this relaxation was demonstrated by the resistance returning (nearly) to the original value after repeated temperature cycling and equilibration. The reversible characteristic of the relaxation suggests that the mechanism is the change in chemical short-range order with temperature. Thus the measurements provide information on atomic mobility in this metallic glass. The relaxation kinetics indicate a broad spectrum of relaxation times which is best described as lognormal but skewed towards longer times. Parameters describing the breadth and shift in this spectrum with temperature will be described. We also observed an irreversible resistance change superimposed on the reversible changes. The kinetics of the irreversible change were found to obey the equation for free volume relaxation proposed by van den Buekel. However, his "mixed" CSRO-TSRO kinetics model fails to describe the slowing of the CSRO kinetics that occurs early in the annealing process.

37223 **(LA-UR—87-2198) High-strain-rate deformation mechanisms in copper and implications for behavior during shock-wave deformation.** Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 19p. (CONF-870753—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011733.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A recently developed model for the deformation of copper is reviewed. The model separates the kinetics of structure evolution from those at constant structure and uses the mechanical threshold stress (yield stress at 0°K) as an internal-state variable. Predictions of the stress-strain behavior at high strain rates are compared with experimental results, and the potential application of the modeling procedure in the shock-wave regime is discussed.

37224 **(LBL—22476) Aluminum substitutions in Nd-Fe-B sintered magnets.** Chen, J.K.; Thomas, G. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering; Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 18p. (CONF-870438—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011104.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

A microstructural and microanalytical study of aluminum substituted Nd-Fe-B sintered permanent magnets were carried out to determine the effect, if any, of aluminum on structure, composition, and magnetic properties, particularly on the observed increase in coercivity. It was found that Al enrichment occurred in the Nd-rich phase at the grain boundaries. The possible role(s) of this enrichment on the observed coercivity increase are discussed.

37225 **(LBL—22477) Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets.** Ramesh, R.; Thomas, G.; Ma, B.M. (Lawrence Berkeley Lab., CA (USA); Crucible Research Center, Pittsburgh, PA (USA)). May 1987. Contract AC03-76SF00098. 24p. (CONF-870438—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011028.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

It is shown that increasing additions of Dy causes the remanence B/sub r/ to decrease linearly. The intrinsic coercivity, iHc, increases sharply for small additions of Dy, but the increase is not proportional for higher Dy contents. The iHc increases almost linearly with the effective anisotropy field of the $RE_2Fe_{14}B$ phase until the Dy content is about 10% of the total rare earth content. Above this concentration, there is strong deviation from linearity. Various types of possible concentration profiles of the substituted rare earth are suggested. It is also argued that preferential segregation of Dy to the interfaces could be beneficial in increasing the nucleation field. Morphologically there is no apparent effect of Dy on the microstructure. However, in the 5 atomic % Dy sample, Dy rich oxides were observed. It is shown through Energy Dispersive Xray Spectroscopy (EDXS) line profiling that Dy partitions preferentially into the $RE_2Fe_{14}B$ phase in all the cases. No segregation of Dy to the interphase interfaces has been detected.

37226 **(LBL—23530) Magnetic susceptibility of AuFe: T/sub g/ and Curie-Weiss parameters.** Fisher, R.A.; Phillips, N.E.; Seto, M. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 11p. (CONF-870873—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011100.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The dc field-cooled susceptibilities, chi, of annealed AuFe with nominal concentrations, c, of 0.5, 1 and 2 at. % Fe have been measured in the ranges $2 \leqq T \leqq 150K$ and $1 \leqq H \leqq 50{,}000G$. Spin-glass temperatures, T/sub g/, were determined from the cusps in chi at low field. Analysis of the data above 3T/sub g/ determined the Weiss constants, Θ, and the effective magneton numbers, p. Assuming $S = 3/2$ for Fe, values of g, the spectroscopic splitting factor, were derived from p.

37227 **(LBL—23532) Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field.** Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Phillips, N.E.; Flouquet, J.; Amato, A.; Jaccard, D. (Lawrence Berkeley Lab., CA (USA); Centre National de la Recherche Scientifique, 38 - Grenoble (France). Centre de Recherches sur les Tres Basses Temperatures; Geneva Univ. (Switzerland). Dept. de Physique de la Matiere Condensee). Apr 1987. Contract AC03-76SF00098. 9p. (CONF-870873—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011096.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The specific heat, C, of a single crystal of $CeCu_6$ has been measured between 0.06 and 20K to pressures, P, of 8.8 kbar, and between 0.3 and 20K in magnetic fields, H, to 7.5T. At zero H and P, a minimum in C/T is observed near 8K. Below that temperature C/T increases, and below 1K is linear in T, $C/T = 1.67 - 0.67T$ J/mole $K^2$. No maximum in C/T is found. This increase in C/T is reduced by a factor of three at 8.8 kbar and virtually completely suppressed for $H = 7.5T$ along the [001] axis. With H parallel [100] and [010] axes the effect on C is small.

37228 **(LBL—23533) Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure.** Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Phillips, N.E.; Fisk, Z.; Smith, J.L. (Lawrence Berkeley Lab., CA (USA); Los Alamos National Lab., NM (USA)). Apr 1987. Contract AC03-76SF00098. 9p. (CONF-870873—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011097.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The specific heat, C, of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ has been measured for $0.1 \leqq T \leqq 1K$ and $1.6 \leqq P \leqq 7.7$ kbar, and for $0.1 \leqq T \leqq 20K$ with $P = 0$. For $T > 8K$ both the pure and Th substituted samples have essentially the same C. The peaks in C/T at 0.33 and 0.54 for $P = 0$ are suppressed and shifted to lower T by pressure. Anomalies in C/T can be correlated to corresponding rapid changes in magnetic susceptibility, chi. Rapid suppression of the peaks and shift of T/sub c/ to lower values is in marked contrast to the behavior found for pure $UBe_{13}$ whose single peak amplitude decreases approximately linearly with P to about 60% at 9.3 kbar. The broad "shoulder" in C/T near 2K that is found for $UBe_{13}$, but not for any other heavy-fermion compound, HFC, is completely suppressed in the Th substituted sample.

**37229 (N—87-20566) Shot peening for Ti-6Al-4V alloy compressor blades.** Carek, G.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 9p. (NASA-TP—2711; E—3430; NAS—1.60:2711). NTIS, PC A01/MF A01.

A text program was conducted to determine the effects of certain shot-peening parameters on the fatigue life of the Ti-6Al-4V alloys as well as the effect of a demarcation line on a test specimen. This demarcation line, caused by an abrupt change from untreated surface to shot-peened surface, was thought to have caused the failure of several blades in a multistage compressor at the NASA Lewis Research Center. The demarcation line had no detrimental effect upon bending fatigue specimens tested at room temperature. Procedures for shot peening Ti-6Al-4V compressor blades are recommended for future applications.

**37230 (N—87-21077) Superalloy resources: Supply and availability.** Stephens, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 47p. (NASA-TM—89866; E—3305; NAS—1.15:89866). NTIS, PC A03/MF A01.

Over the past several decades there have been shortages of strategic materials because of our near total import dependence on such metals as chromium, cobalt, and tantalum. In response to the continued vulnerability of U.S. superalloy producers to disruptions in resource supplies, NASA has undertaken a program to address alternatives to the super-alloys containing significant quantities of the strategic materials such as chromium, cobalt, niobium, and tantalum. The research program called Conservation of Strategic Aerospace Materials (COSAM) focuses on substitution, processing, and alternate materials to achieve its goals. In addition to NASA Lewis Research Center, universities and industry play an important role in the COSAM Program. This paper defines what is meant by strategic materials in the aerospace community, presents a strategic materials index, and reviews the resource supply and availability picture from the U.S. point of view. In addition, research results from the COSAM Program are highlighted and future directions for the use of low strategic material alloys or alternate materials are discussed.

**37231 (ORNL/Sub—85-27488/01) The strengthening mechanisms in modified AISI 316 stainless steels.** Carolan, R.A.; Li, Che-Yu; Maziasz, P.J.; Swindeman, R.W.; Todd, J.A. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering; Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011983.

The flow strength of a series of modified type AISI 316 austenitic stainless steels with stabilizing additions and with combined copper and stabilizing additions were evaluated after various thermo-mechanical treatments at elevated temperatures by using the load relaxation technique. The test results showed that there is a synergistic increase in strength when both copper and stabilizing additions are made and combined with prior cold work before stabilization treatment. Microstructural examination showed that copper increases the nucleation rate of MC type precipitation on grain matrix dislocations produced by cold work creating a fine distribution of these precipitates. This precipitation process enhances the strength of the steels and improves microstructural stability at elevated temperatures. 13 refs., 18 figs., 2 tabs.

**37232 (RFP—3987) Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate.** Wood, D.H.; Jackson, R.J.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 24 Apr 1987. Contract AC04-76DP03533. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87012303.

Three different plate fabrication processes were used to produce unalloyed uranium plates having three different microstructures. Each plate type had distinctively different crystallographic textures and each had different levels of strain hardening. Standard Charpy V-notch bars were machined from the plates at five different orientations with respect to the rolling direction. These bars were tested at temperatures from -60 to +200°C at 20° intervals, and ductile-brittle transition temperature (DBTT) curves were constructed. A strong directional effect of the DBTT was observed and explained in terms of crystallographic texture anisotropy. Similarly, a strong, non-directional effect on the DBTT was observed and explained in terms of hydrogen content and the level of strain hardening.

**37233 (RFP—4046) Acoustic emission produced by deformation of metals and alloys.** Heiple, C.R.; Carpenter, S.H.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 9 Mar 1987. Contract AC04-76DP03533. 82p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87012300.

Acoustic emission is frequently produced during deformation of metals and alloys. Numerous mechanisms can be responsible for the acoustic emission activity. This report is a comprehensive review of the literature concerning acoustic emission produced during deformation by dislocation motion, deformation twinning, as well as inclusion fracture and decohesion. 232 refs., 30 figs.

**37234 (RFP—4048, pp 1-9) Origin of trace element effects on GTA weld pool shape.** Heiple, C.R.; Burgardt, P.; Roper, J.R. 28 Nov 1986. NTIS, PC A04/MF A01. File Number DE87008544. (CONF-8511282—).

From Conference on progress in resolving undersirable trace element effects on the weldability of steels; Charlotte, NC, USA (21 Nov 1985).

The surface tension driven fluid flow model originally proposed to explain the effect of trace elements on GTA weld penetration has been used to understand the interaction between base metal chemistry and welding parameters in determining weld shape. The proposed model is supported by measurements of the response of weld pool shape to beam power density in an electron beam weld on two heats of 304 stainless steel with different sulfur levels. The response of weld shape to base metal sulfur level and input power density at moderate power densities was similar to that observed IN GTA welds. There are a number of possible approaches to eliminating GTA weld shape variability, including doping the shielding gas or filler wire with surface active elements, changing welding parameters to make the process less sensitive to chemistry variations, and changing material specifications to require a minimum as well as maximum in surface active residual element content. Promixing preliminary results are being obtained with all these approaches. 26 references, 6 figures.

**37235 (RFP—4048, pp 10-29) Minor element effects on gas tungsten-arc weld penetration.** Sundell, R.E.; Walsh, H.D.; Harris, L.P.; Correa, S.M.; Walsh, D.W.; Savage, W.F. (General Electric Co.). 28 Nov 1986. NTIS, PC A04/MF A01. File Number DE87008544. (CONF-8511282—).

From Conference on progress in resolving undersirable trace element effects on the weldability of steels; Charlotte, NC, USA (21 Nov 1985).

This report summarizes the results of a project to investigate and develop a means to control the influence of minor element concentrations on gas tungsten-arc (GTA) weld penetration. Large variations in the depth of weld penetration between different heats of the same alloy present a severe challenge to making reproducible welds with an automated welding system. This investigation is a joint effort of General Electric Corporate Research and Development (GE-CRD) and Rensselaer Polytechnic Institute (RPI), as

part of the Nation Science Foundation's Industry/ University Cooperative Research Program. The research program is divided into three integrated tasks: (1) Weld Penetration Control (RPI), (2) Weld Pool Flow (GE-CRD), and (3) Arc Physics Modeling (GE-CRD). The results of experiments at RPI are reported that systematically determine the effect of separate alloying elements and shielding gas additions on weld pool dimensions for AISI 8630 low alloy steel. In general, sulfur additions increased the weld pool depth-to-width (d/w) ratio and oxygen additions to the shielding gas increased the weld pool depth and volume. Also, Oxygen additions minimized heat-to-heat variability in weld pool depth. 33 references, 19 figures, 5 tables.

37236 (RFP—4048, pp 30-50) **Effects of minor elements on the welding characteristics of stainless steel.** Pollard, B. (LTV Steel Co.). 28 Nov 1986. NTIS, PC A04/MF A01. File Number DE87008544. (CONF-8511282—).

From Conference on progress in resolving undersirable trace element effects on the weldability of steels; Charlotte, NC, USA (21 Nov 1985).

The effects of systematic variations in the aluminum, sulfur, silicon, manganese, phosphorus, molybdenum, and copper contents on the penetration and slagging characteristics of laboratory heats of Type 304 stainless steel were investigated. The effects of aluminum and sulfur on penetration in tungsten inert gas welding can be satisfactorily explained in terms of their effects on the temperature coefficient of surface tension and the theory of surface tension driven fluid flow. However, the results for silicon and manganese are more complex, and, while not inconsistent with the surface tension derived fluid flow model, indicate that other factors besides the temperature coefficient of surface tension must be taken into account. In the case of silicon, its influence on the viscosity of the molten metal appears to have a significant effect on penetration. As expected P, Mo, and Cu had no effect on penetration since they are not surface active elements, nor likely to interact with surface active elements and, therefore, have no effect on the temperature coefficient of surface tension. Penetration values for production heats of Types 304 and 316 stainless steel showed a strong dependence on sulfur content but were lower than for the laboratory heats, which was attributed to their lower oxygen contents. Slag formation during the GTA welding of stainless steels was found to be caused primarily by the oxide inclusions in the steel. Compositional limits for stainless steel with welding characteristics suitable for the production of welded tubing are given. 31 references, 13 figures, 4 tables.

37237 (RFP—4048, pp 51-54) **Investigations at the Welding Institute.** Hauser, D. (Edison Welding Institute). 28 Nov 1986. NTIS, PC A04/MF A01. File Number DE87008544. (CONF-8511282—).

From Conference on progress in resolving undersirable trace element effects on the weldability of steels; Charlotte, NC, USA (21 Nov 1985).

References of articles that discuss metallurgical aspects of heat-to-heat variations in GTA, LBW, and EBW weld penetration are discussed. Samples of various austenitic stainless steel sheet (Types 304, 304L, 316, 316L, 321, and 347) and 2-1/4Cr-1Mo low-allow steel tube were furnished by member organizations for investigation. All of the materials were chemically analyzed, including analysis for selected residual elements that would not routinely be included. All welds were melt runs (conduction limited) to eliminate any effects of joint preparation. The parameter most sensitive to variations in fusion behavior was found to be d/w, the ratio the depth of penetration d to the width of the weld face, w. Each weld was sectioned five times with a minimum spacing of 10 mm between sections and the d/w values were measured; the mean value and standard deviation of each parameter were calculated. The d/w for the stainless steels ranged from 0.15 to 0.60 with most of the results in the range 0.35 to 0.50. Values of d/w for the low alloy steel were 0.25 to 0.47. Because all of the tubes originated from one source, relatively consistent behavior might be expected. For both alloy groups, the variations in d/w among heats always were greater than among welding runs with a single heat, and for a given set of welding parameters and equipment, variable fusion behavior of a single heat should not be a problem. 4 references.

37238 **(SAND—85-2568) Sliding and thermally induced surface segregation in a gold based precious metal alloy.** Lloyd, J.N.; Vook, R.W.; Pope, L.E. (Syracuse Univ., NY (USA). Lab. of Solid State Science and Technology; Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011608.

Thermally induced surface segregation has been measured on a gold based alloy (ASTM B541). Comparisons were made among abraded, "as-received" and wear track surfaces that were ion-sputter cleaned before heating. The wear tracks were formed by oscillatory sliding in a pin-on-plate apparatus; the pin was made from a palladium based alloy (ASTM B540). Wear tracks and heating were accomplished in situ in an ultrahigh vacuum system. The elemental compositions were measured with Auger electron spectroscopy. Previous results that sulfur segregates to wear tracks due to rubbing alone and that the source of the sulfur was the bulk materials were confirmed. Sulfur segregation to the surfaces during heating was observed for all surface preparations; however, sulfur segregation was significantly greater in the wear track than on the abraded surface. In the case of the unabraded surface, a highly anisotropic distribution of sulfur was observed and was attributed to enhanced diffusion of sulfur along grain boundaries and/or defects in the near-surface material. Thermal segregation was strongly influenced by the thermal treatment of the sample.

37239 **(SAND—86-2670C) Electronic structure of boron and boron rich borides.** Switendick, A.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870438—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010779.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The electronic structure of cubic $B_{12}$ and $B_{12}P_2$ has been calculated using the linear augmented plane wave method. These calculations are self-consistent and include calculation of the total energy. Within the strict muffin tin approximation (spheres centered only on atomic positions-constant potential otherwise) these systems are unbound with respect to the atomic constituents. Using interstitial spheres, up to 77% of the unit cell can easily be filled to yield much more reasonable total energies. Although the improvement in the total energy is significant upon including the interstitial spheres, the band structure and densities of states are not significantly changed. Similarly, the real atomic charge distributions (B, P) are little changed, while the interstitial distribution does change to reflect the additional freedom provided by the interstitial spheres. Results including the rhombohedral and icosohedral distortions in both systems are discussed. Gaps are found to open up in the alpha rhombohedral boron and in the $B_{12}P_2$ systems as are observed experimentally.

37240 **(SAND—87-0071C) Metastable phase boundaries of quasicrystalline phases.** Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 27p. (CONF-870893—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010741.

From 6. international conference on rapidly quenched metals; Montreal, Canada (3 Aug 1987).

The melting curve ($T_o$) of the metastable icosahedral phase and the liquidus of the decagonal phase of Al-Mn have been obtained for 14 to 22 at. % Mn. Icosahedral Al-Mn has a congruent melting point of 910 +- 20°C at 20 at. % Mn, and melts ~30°C lower than crystalline compounds with the same composition. Icosahedral $Al_{82}Ru_{18}$ was determined to melt at 1260 +- 30°C. These results were obtained by forming single-phase icosahedral alloys with ion beam mixing, and by rapid heating to accurately known temperatures with electron beams.

37241 **(SAND—87-0622C) Dynamic quasi-isentropic compression of tungsten.** Chhabildas, L.C.; Barker, L.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870753—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011059.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Experiments have been performed both on the powder gun and two-stage light gas gun to obtain quasi-isentropic compression in tungsten to stresses of 78 and 250 GPa, respectively. Quasi-isentropic loading was introduced in the material either by using graded density or layered materials. The former introduces a smooth and a finite rate of loading at the impact interface whereas the latter introduces a series of small multiple shocks into the material. Results of both experiments indicate that the quasi-isentrope lies above the Hugoniot up to ~140 GPa, contrary to initial expectations. These results suggest that the dynamic yield strength of the material is dependent on the loading rate with the strength of the material being higher for the relatively slower rates of isentropic loading.

37242 **(SAND—87-0741C) A strain-rate-dependent spall mechanism transition in metals.** Grady, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870769—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011637.

From APS topical conference on shock waves in condensed matter; Monterey, Canada (20 Jul 1987).

A prediction of the spall strength of metals in reasonable accord with experimental data can be derived from an energy-balance theory of the spall process. In the theory a model of ductile spall (Y-dominated ductile hole growth and coalescence) and brittle spall (K/sub c/-dominated crack growth and coalescence) is assumed. In the present study it is proposed that in certain metals a transition from brittle (K/sub c/-dominated) to ductile (Y-dominated) spall can occur with variation in the rate of dilatant strain. The predicted behavior is compared with spall data for 6061-T6 aluminum, for which this transition is calculated to occur at rates consistent with common impact applications.

37243 **(UCID—20676) Radiation effects limits on superconducting magnets: Data base for copper stabilizers.** Guinan, M.W. (Lawrence Livermore National Lab., CA (USA)). 24 Feb 1986. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011906.

A simple model has been developed which can predict the magnetoresistance of copper as a function of initial purity, the extent of cold work and the presence of both irradiation produced point defects and the extended defects produced by annealing. The remaining area of uncertainty in a complete description of the response of superconducting magnets to irradiation-anneal cycles is the dependence of annealing on dose impurity concentration and cold-work.

37244 **(UCRL—96643) FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements.** Flower, E.C.; MacEwen, S.R.; Holden, T.M. (Lawrence Livermore National Lab., CA (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario). May 1987. Contract W-7405-ENG-48. 13p. (CONF-870772—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011562.

From 2. international conference on advances in numerical methods in engineering: theory and application; Swansea, UK (6 Jul 1987).

Residual stresses in a body arise from nonuniform plastic deformation and continue to be an important consideration in the design and the fabrication of metal components. The finite element method offers a potentially powerful tool for predicting these stresses. However, it is important to first verify this method through careful analysis and experimentation. This paper describes experiments using neutron and x-ray diffraction to provide quantitative data to compare to finite element analysis predictions of deformation induced residual stress in a plane stress austenitic stainless steel ring. Good agreement was found between the experimental results and the numerical predictions. Effects of the formulation of the finite element model on the analysis, constitutive parameters and effects of machining damage in the experiments are addressed.

37245 **(UCRL—96787) Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method.** Turchi, P.E.A.; Gonis, A.; Zhang, X.; Stocks, G.M. (Lawrence Livermore National Lab., CA (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy; Oak Ridge National Lab., TN (USA)). 10 Jun 1987. Contract W-7405-ENG-48. 15p. (CONF-8706103—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011561.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

Starting from the formal expansion of the configurational energy in terms of fully renormalized effective cluster interactions, it is shown that the Embedded Cluster Method (ECM) and the Generalized Perturbation Method (GPM) lead to identical expressions for the energy of a given alloy configuration within the Coherent Potential Approximation (CPA). Correction terms associated with fluctuations in the reference medium can be calculated in both methods. Numerical results are presented for model Tight Binding Hamiltonian which clearly indicate the significance of multisite cluster interactions in the determination of the tendencies toward ordering or phase separation and phase stability in alloys.

37246 **Structure of liquid equiatomic potassium—lead alloy: A neutron diffraction experiment.** Saboungi, M.; Blomquist, R.; Volin, K.J.; Price, D.L. (Argonne National Laboratory, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **87**: No. 4, 2278-2281(15 Aug 1987). Contract W-31-109-ENG-38.

Neutron diffraction measurements have been performed on liquid equiatomic potassium—lead alloy at T = 870, 900, and 930 K to determine the influence of temperature on the structure. A well-defined first sharp diffraction peak (FSDP) at Q = 0.96 $A^{-1}$, similar to that found in glassy materials, was obtained in the total structure factors S(Q) at the three temperatures. While the position of the peak remained unaffected by temperature changes, its magnitude decreased with increasing temperature. The other features of S(Q) were almost unaltered by temperature, as expected. The FSDP can be related to the presence of chemical bonds or clusters whose stability decreases with increasing temperature. A molecular model based on the random packing of $K_4Pb_4$ structural units is shown to give a remarkable correspondence with the measured structure factors.

37247 **Thermal roughening of the copper (110) surface: An x-ray diffraction experiment.** Mochrie, S.G.J. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **59**: No. 3, 304-307(20 Jul 1987).

The roughness of the (110) surface of face-centered-cubic copper has been measured between 200 and 700 °C, by x-ray diffraction. The changes observed are reversible and suggest a roughening temperature of T/sub R/≅600 °C. This value is compared with simple theoretical estimates and found to be in satisfactory agreement.

37248 **Ion channeling and catastrophe theory.** Neskovic-acute-accent, N.; Perovic-acute-accent, B. (Boris Kidri Institute of Nuclear Sciences, Belgrade, Yugoslavia). *Physical Review Letters;* **59**: No. 3, 308-310(20 Jul 1987).

The rainbow effect in ion channeling (in very thin crystals) is considered. In the analysis the results of catastrophe theory are used. The calculations were performed for 10-MeV $H^+$ ions and the <100> channel of a 1000-A-thick Au crystal.

37249 **Temperature-induced magnetism in FeSi.** Shirane, G.; Fischer, J.E.; Endoh, Y.; Tajima, K. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 3, 351-354(20 Jul 1987). Contract AC02-76CH00016.

We report neutron-scattering measurements with polarization analysis on a large single crystal of FeSi up to 650 K. A strongly q-dependent magnetic scattering is observed around (011) and the intensity follows the unusual shape of the static susceptibility. Surprisingly, the energy-integrated magnetic cross sections are

almost q independent. This represents an entirely new kind of magnetism which, overall, supports the picture of temperature-induced moment in FeSi.

37250 **Comment on"Realistic calculation of the indirect-exchange interaction in metals".** Harmon, B.N.; Wang, X.W. (Ames LaboratoryU.S. Department of Energy, Energy & Mineral Resources Research Institute, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* **59**: No. 3, 379-379(20 Jul 1987). Contract W-7405-ENG-82.

A Comment on the Letter by S. J. Frisken and D. J. Miller, Phys. Rev. Lett. 57, 2971 (1986).

37251 **Effect of liquids on the Drude dielectric function of Ag and Au films.** Chen, L.; Lynch, D.W. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **36**: No. 3, 1425-1431(15 Jul 1987).

Spectroscopic ellipsometric measurements were made of the free-electron dielectric functions of Ag and Au films in air and immersed in dielectric liquids of different refractive indexes. The effects seen by Gugger et al. were reproduced for Ag and Au films prepared similarly to theirs, and in Ag films with larger grains. Different effects were seen with an (oxidized) single crystal of Ag and a single crystal of Au. The "anomalous" data could be fitted with an effective-medium model by assuming that the liquid penetrates all, or most, of the intergrain regions within the optical penetration depth. The dielectric functions of "ideal" Ag and Au samples were obtained from fits with an effective-medium model.

37252 **Mass renormalizations and superconductivity in heavy-fermion $UPt_3$.** Norman, M.R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **59**: No. 2, 232-235(13 Jul 1987). Contract W-31-109-ENG-38.

The Eliashberg equations for magnetic fluctuations are solved for the case of $UPt_3$. As input, the neutron data of Aeppli et al. are used for the spectral function, and the results of band-structure calculations are used to model the Fermi surface. The results indicate a mass renormalization factor of about 16, a value confirmed by comparisons of band calculations to de Haas—van Alphen data. Moreover, a superconducting transition temperature of the order of 0.1—0.2 K is calculated (due to the momentum dependence of the susceptibility) with polar gaps in parts of the zone.

37253 **Effect of tensile stress on the annealed structure of a metallic glass.** Vianco, P.T.; Li, J.C.M. (Materials Science Program, Department of Mechanical Engineering, University of Rochester, Rochester, New York 14627). *Journal of Materials Research;* **2**: No. 4, 461-470(Jul 1987).

The low-temperature (120°—245 °C) structural relaxation of Metglas/sup R/ 2826B ($Ni_{40}Fe_{29}P_{14}B_6Si_2$) amorphous alloy was investigated for samples subjected to a tensile stress in the range of 20—400 MPa during annealing. The stress-annealed samples demonstrated a much smaller increase of microhardness than was observed in similarly annealed ribbons without a stress. Further heat treatment of the stress-annealed specimens, this time without the stress, was capable of increasing the microhardnesses of only some ribbons to values equal to those of samples similarly heat treated initially without a stress. An additional exothermic peak in the differential scanning calorimetry (DSC) thermograms of the stress-annealed specimens indicated the presence of a more disordered structure at room temperature, which was found to correlate with the lower microhardness values. Otherwise, those artifacts of the DSC thermograms that were characteristic of samples annealed without a stress were still present in the stress-annealed ribbons. No effect on the crystallization temperature was noted but the glass transition temperature was increased in the stress-annealed case with respect to values attained when the stress was absent during heat treatment. A reduction in the degree of embrittlement of those samples annealed with a tensile stress was a further indication of more disorder in the stress-annealed ribbons.

37254 **Structure and electrical properties of metal contacts on GaAs.** Liliental-Weber, Z. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **5**: No. 4, 1007-1014(Jul 1987).

This paper reports a study of the changes in the structural and chemical properties of Au and Al contacts on GaAs at annealing temperatures where significant changes in the Schottky barrier height are found. The annealing of Au contacts above 290 °C caused the Schottky barrier height to decrease. In contrast the Schottky barrier height of Al diodes increases upon annealing. An increase in As/Ga ratio in the GaAs under the as-deposited metal was consistently found in both cases. Upon annealing the As/Ga ratio is found to decrease for Al contacts, while it is found to increase for Au contacts. The orientation relationship of the Au contacts changed upon annealing. This was not observed with the annealed Al. The orientation relationship depended strongly on the surface preparation before the metal deposition and on the annealing environment. It was proposed that the presence of As at the interface can determine the orientation relationship between metals and GaAs.

37255 **Importance of spacing in the development of high current densities in multifilamentary superconductors.** Gregory, E.; Kreilick, T.S.; Wong, J.; Ghosh, A.K.; Sampson, W.B. (Supercon, Inc., Shrewsbury, MA, USA; Brookhaven National Lab., Upton, NY, USA). *Cryogenics;* **27**: No. 4, 178-182(Apr 1987).

It has been shown that by reducing the spacing between the filaments and keeping all the other factors the same, significant increases in current density can be achieved in conventional multifilamentary Nb-Ti superconductors of the type used in the Colliding Beam Accelerator and Tevatron dipole magnet designs.

37256 **(UCRL-Trans—12178) Creep of austenitic stainless steels at room temperature.** Castro, R.; Tricot, R.; Rousseau, D. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. Translated from Steel-strengthening mechanisms symposium; Zurich, Switzerland, May 5-6, 1969, pp 117-134. (CONF-690588—1-Trans.). 52p. NTIS MF A01; 2; GPO Dep. File Number DE87009118.

From Steel-strengthening mechanisms symposium; Zurich, Switzerland (5 May 1969).

A notable characteristic of the room-temperature mechanical behavior of austenitic stainless steels is creep even under moderate loads. The magnitude of this creep has been studied on three steels with 0.06% C, 18% Cr and nickel contents of about 13, 8 and 7%, showing decreasing stability of the austenite to structural transformations induced by cooling to low temperatures and/or deformation. The nature and extent of these transformations are detailed and several examples are given of the morphology of the resultant constituents. Creep tests on specimens solution treated at 1050°C and air cooled were made at loads ranging from initial stresses below the conventional 0.2%-offset yield strength to initial stresses near the tensile strength. These tests showed that austenitic stainless steels generally follow a logarithmic creep law. The influence of structural transformations induced by deformation on this behavior is discussed. The occurrence of the austenite $\rightarrow \alpha'$ martensite (bcc) transformation is accompanied by a significant retardation of creep but without a noteworthy change in the nature of the responsible mechanism. Finally, these tests indicated that plastic deformation of austenitic stainless steels always favors - either by simple work hardening or by partial destabilization of the austenite - the adaptation of the mechanical strength of the metal to the applied loads. This behavior guarantees the safety of installations from rupture and demonstrates why rational utilization of austenitic stainless steels can be obtained only if allowable design stresses are not established merely by reference to the 0.2%-offset yield strength of the solution-treated alloy. 42 figs., 5 tabs.

**37257 Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system.** Squattrito, P.J.; Yun, H.; Ibers, J.A. (Dept. of Chemistry, Northwestern Univ., Evanston, IL 60201). *Materials Research Bulletin;* **22**: No. 1, 75-82(Jan 1987).

A pyrite-like phase of composition Ir/sub 2.7/Se/sub 8/ has been prepared; it has been characterized by X-ray and neutron powder diffraction techniques. The Ir-Se phase differs from the corresponding Rh-Se phase in the distribution of metal atom defects, the nature of structural distortions influenced by such defects, and the energetic relationship between the distorted and undistorted structures.

**37258 Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys.** Sorensen, N.R.; Diegle, R.B.; Picraux, S.T. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). *Corrosion (Houston);* **43**: No. 1, 2-7(Jan 1987). Contract AC04-76DP00789.

The passivation of phosphorus-implanted Fe-6Cr and Fe-18Cr alloys has been investigated in 0.1 N H/sub 2/SO/sub 4/ with and without the addition of chloride ions. The implantation process causes a change in microstructure from crystalline to amorphous as the total P fluence increases. Implantation with 1.5 x 10/sup 17/ P/cm/sup 2/ to form peak concentrations of — 20 atomic percent (at%) increases the passivation rate and decreases the total charge passed during film growth in the absence of Cl ions. When 500 ppm Cl is added to the solution, the P-implanted Fe-18Cr alloy passivates while the Fe-6Cr material pits. This behavior is explained in terms of the effect of P on Cr-containing alloys and their tendency to passivate.

**37259 Estimates of incubation and completion times in recrystallization.** Price, C.W. (Chemistry and Materials Science Dept., The Univ. of California). *Scripta Metallurgica;* **21**: No. 1, 49-52(Jan 1987).

Values of t* and t/sub f/ obtained by the technique presented in this paper provide reasonable estimates of incubation and completion times. Because of the approximations used in the computer model and the empirical relations used in the derivation of an equation, these times should be considered as apparent or effective times. Topics considered include metals, recrystallization, time dependence, incubation, computerized simulation, and equations.

**37260 Anisotropic Schmid factors in constrained systems.** Price, C.W. (Chemistry and Materials Science Dept., Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). *Scripta Metallurgica;* **21**: No. 1, 65-70(Jan 1987). Contract W-7405-ENG-48.

Elastic incompatibility at grain boundaries in strained, anisotropic materials can cause the operation of secondary dislocation sources. In computer simulations of elastically strained, symmetrical, tilt boundaries, this elastic incompatibility can be modeled by constraining the lattices to prevent shear. When a system is constrained against shear, the conventional Schmid factor applies only to the isotropic case. The purpose of this paper is to derive an anisotropic Schmid factor for the case of constrained shear. Constraints against shear also may cause the operation of unexpected slip systems in anisotropic crystals. In BCC crystals, this could contribute to observations of anomalous slip and asymmetric slip in tension and compression.

**37261 Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel.** Chatterjee, A.; Hirth, J.P.; Hoagland, R.G.; Choudhury, .A.; White, C.L. (Ames Lab., Iowa State Univ., Ames, IA 50011). *Scripta Metallurgica;* **21**: No. 1, 79-82(Jan 1987).

This paper presents results which indicate either boron segregation to prior austenite grain boundaries or the formation of very small borocarbide clusters or precipitates. In either case the localized boron is deleterious in enhancing intergranular hydrogen embrittlement in the absence of any other solute enhancement except carbon. Boron containing steel should be used with caution in applications where exposure to hydrogen is a possibility.

**37262 Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity.** Rose, J.H. (Iowa State Univ., Ames). pp 1419-1424 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

Recently, several papers have dealt with the use of the frequency dependent ultrasonic attenuation to characterize gas porosity in structural solids such as cast aluminum. The methods proposed provide an estimate of the volume fraction of pores and the average pore size. The estimate of the volume fraction for laboratory samples has been sufficiently accurate that it encourages thoughts of routine industrial use. In the past year, they have considered several corrections which may be of use in transferring the laboratory methods to industrial samples. Three corrections have been developed. The first is a simple way of accounting for the effects of as-cast surface roughness on the inference of ultrasonic attenuation from phase-sensitive scattering measurements. This topic will be dealt with in the companion paper by Nagy et al. The second correction deals with the effects of nonspherical pores on the inference of the volume fraction. This effect can be very substantial (e.g., a distribution of microcracks may lead to a large ultrasonic attenuation while having zero volume fraction). Finally, the third correction deals with the effects of multiple scattering. That is, the methods used up until now have relied on the scattering being uncorrelated (which is reasonable for low density gas porosity, i.e., volume fractions < 2%). However, at higher volume fractions this assumption begins to breakdown. They propose a strategy based on the Kramers-Kronig relations for including multiple scattering effects. The last two corrections are the subject of this paper.

**37263 Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy.** Nagy, P.B.; Rypien, D.V.; Adler, L. (Ohio State Univ., Columbus). pp 1435-1442 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

Porosity assessment of flat smooth surface cast aluminium samples by ultrasonic attenuation spectroscopy were found to be in good agreement with other porosity assessment methods. Ultrasonic results were also obtained for samples with their as-cast rough surfaces intact. The volume fraction of porosity in these samples was unacceptably underestimated. Since it is infeasible to maintain a smooth surface, especially for large castings prior to ultrasonic assessment, a technique to compensate for surface roughness was considered in this paper. It consists of a first order phase perturbation to calculate the surface roughness induced attenuation for both reflected and transmitted components at normal incidence on a liquid-solid interface. Results using this analysis for a Gaussian distributed surface are shown.

**37264 Use of ultrasonics for texture monitoring in aluminum alloys.** Clark, A.V. Jr.; Govada, A.; Thompson, R.B.; Smith, J.F.; Blessing, G.V.; Delsanto, P.P.; Mignogna, R.B. (National Bureau of Standards, Boulder, CO). pp 1515-1524 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The authors have identified a key step in aluminum can production where ultrasonics can be used as a process control monitor; namely texture measurement after hot rolling. Ultrasonic techniques which appear the most promising are measurement of angular variation of $SH_0$- and S/sub o/-modes. These both are measure of ODC, $omega_{440}$, which characterized cube texture well and increased as exit temperatures decreased. This result, in qualitative agreement with metallurgical considerations, is a necessary condition for the use of in-process ultrasonic texture monitoring.

37265 **Influence of plate wave characteristics on the angular dependence of ultrasonic velocities.** Thompson, R.B.; Smith, J.F.; Lee, S.S. (Iowa State Univ., Ames,). pp 1525-1531 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The angular dependence of the velocities of ultrasonic plane waves in a stressed, orthorhombic (orthotropic) continuum has recently been analyzed, and the results have been used to define scenarios for non-destructively measuring stress and preferred grain orientation. These techniques make use of particular features which allow the two sources of anisotropy, stress and texture, to be separately determined. However, experimental realization of these ideas involves measurements at surfaces, and the influence of the surfaces on the plane wave solution must be considered. This paper treats the case of an orthorhombic plate, thin with respect to a wavelength. Discussions of the extensional and horizontal shear plate mode velocities appear in the mechanics literature, and their application to the characterization of the elastic constants of metal matrix composite plates has been investigated. Here the theory is again briefly derived but in the previous notation so as to allow the analytical expressions already obtained for the angular dependence of plane wave solutions to be directly compared to those for plate modes. Neglecting the effects of stress, the extent to which the $S_0$ (extensional or fundamental symmetric) and $SH_0$ (fundamental horizontally polarized shear) plate solutions differ from their plane wave L (longitudinal) and SH (horizontally polarized shear) counterparts are discussed. Application of the results to weakly anisotropic metal polycrystals indicates a substantial difference in the anisotropies of the $S_0$ and L solutions. Implication of the results to the ultrasonic measurement of preferred grain orientation (texture) in metal polycrystals is discussed.

37266 **Determining crack tip shielding by means of acoustic transmission and diffraction measurements.** Buck, O.; Rehbein, D.K.; Thompson, R.B. (Iowa State Univ., Ames). pp 1601-1607 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

This paper discusses briefly the origins and consequences of crack tip shielding as well as recent experimental and theoretical efforts to understand the interaction of acoustic waves with contacting asperities. It is shown that the size and density of individual contacts, or asperities, can be estimated and reasonable values for the shielding stress intensity factor obtained. It is suggested that the shielding stress intensity factor provides the necessary information to estimate the fatigue crack propagation rate and, therefore, enhances their capabilities for accurate life prediction.

37267 **On-line inspection of ferromagnetic materials using magnetic NDE methods.** Ranjan, R.; Buck, O.; Thompson, R.B. (Iowa State Univ., Ames). pp 1641-1650 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

One class of recently developed instruments for the nondestructive measurement of grain size make use of the magnetic Barkhausen effect. However, these are calibrated empirically, since no theoretical interpretation of the dependence of the magnetic Barkhausen effect on grain size has been given. In an earlier work, magnetomechanical acoustic emission (MAE), Barkhausen noise and hysteresis curves were studied simultaneously in decarburized steels, having the aforementioned objective in mind. This paper presents results of measurements of magnetomechanical acoustic emission (MAE) and Barkhausen effect for nickel samples of different grain sizes. The results show that in nickel, both the MAE and Barkhausen signals decrease with increasing grain size. The paper discusses these results with the associated micromagnetic mechanisms.

37268 **Computation of fields and signals due to ferromagnetic anomalies.** Sabbagh, H.A.; Sabbagh, L.D. (Sabbagh Associates, Inc., Bloomington, IN). pp 1659-1664 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract AC02-83ER80096.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The authors develop a model for the computation of electromagnetic fields in anomalous regions of ferromagnetic cylinders. The role of electric and magnetic current densities as sources for these fields is explicitly presented. The starting point for the development is the computation of a three-dimensional Green's function for the cylinder, from which the appropriate integral relations between the field and its sources can be derived. The rigorous calculation of the anomalous current source within the anomalous region requires the solution of an integral equation that has the Green's function as its kernel. They do not carry out this calculation, but approximate the anomalous current by the applied field due to the exciting coil (which, for their examples is an infinite solenoid that is coaxial to the cylinder). Once the field within the anomalies is determined, the field external to the wall of the tube may be computed, and this provides the signal that is sensed by a coil, or other means. The anomalies may be either holes or cracks, which affect both the local electrical conductivity and magnetic permeability, or magnetic hard spots, which may alter the magnetic permeability, but not the electrical conductivity. They give examples of the computed fields and signals for a simple slot-like anomaly. These results are useful in the quantitative nondestructive evaluation of ferromagnetic cylinders and other structures.

37269 **Investigation of the microstructural dependence of the magnetic properties of 4130 alloy steels and carbon steels for NDE.** Jiles, D.C.; Verhoeven, J.D. (Iowa State Univ., Ames). pp 1681-1690 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The microstructural dependence of the magnetic properties of AISI 4130 alloy steel and plain carbon steels has been investigated as part of a continuing research program into the use of magnetic methods for quantitative nondestructive evaluation of the mechanical properties and heat treatment of constructional steels. Eight different heat treatments of a specimen of AISI 4130 alloy steel were produced. Measurements of the bulk magnetic properties indicated that the coercivity varied from 6.5 to 22.0 Oe, and that the initial permeability of the normal dc magnetization curve varied from 98 to 281 Gauss/Oe, by modifying the microstructure. These variations are comparable with the changes in magnetic properties caused by the application of stress. The variation of magnetic properties with carbon content of up to 1.0 wt% has also been determined while keeping the microstructure the same, by application of appropriate heat treatments. Two different types of microstructures were studied, the normal lamellar pearlite structure obtained by air cooling or furnace cooling from 800°C, and the spheroidized structure obtained by very slow cooling from 727°C, coupled with repeated thermal cycling over a period of a few days. Finally, they have investigated the relationship between mechanical hardness and the magnetic properties. These results have shown that hardness against both coercivity and permeability yields a locus curve which appears, at first sight, to be independent of the microstructure.

37270 **Ultrasonic detection of weld bead geometry.** Carlson, N.M.; Johnson, J.A. (Idaho National Engineering Lab., Idaho Falls). pp 1723-1730 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract AC07-76ID01570.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The three basic components needed to truly automate a welding machine are being investigated in a joint research effort involving the Idaho National Engineering Laboratory (INEL) and the Massachusetts Institute of Technology (MIT). These are: sensors to detect the physical properties of the weld, a model of the welding process, and a control system that can take signals from the sensors, for use in the feedback control, to the welder. Research programs at the INEL are developing electro-optic and ultrasonic sensors to detect the physical properties of the weld and a model of the welding process to relate these properties to parameters in the control model being developed at MIT. This paper discusses the ultrasonic sensing techniques which detect weld bead geometry on root passes during the gas metal arc (GMA) welding process and the approach for acquiring and evaluating the ultrasonic signal and assessing its quality for use as an input signal to a closed loop controlled welding system.

37271 **Ultrasonic NDE of tubing pinch welds.** Rehbein, D.K.; Hsu, D.K.; Thompson, R.B.; Jones, T.A. (Iowa State Univ., Ames). pp 1737-1746 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

Resistance tube closure welds, referred to as pinch welds, are used to reliably seal small stainless steel tubing. Earlier studies in the ultrasonic examination of these welds demonstrated that gross disbonds could be easily detected from changes in signals either reflected from or transmitted through the bond line. When such disbonds were not present it was found that signals doubly transmitted through the interface showed a trend to lower values as the bond quality decreased. These results were interpreted in terms of a model for the interaction of an ultrasonic wave with an imperfect bond. The model predicted a frequency dependent increase in reflectivity and decrease in transmissivity as the bond quality decreased. The changes were quantified by specifying either the thickness and elastic properties of an oxide layer or the separation and diameter of a distribution of circular cracks at the interface. The decrease in transmissivity agreed qualitatively with experimental trends; there was, however, insufficient microstructural information to quantitatively evaluate the models. Using samples fabricated from 304L stainless steel, this study sought to develop a quantitative understanding of the interaction of ultrasound with a pinch weld, and established a significant quantitative correlation between ultrasonic transmissivity and grain size. The use of this correlation as a process control tool is recommended.

37272 **Ultrasonic evaluation and imaging of tube closure welds.** Thomas, G.H.; Spingarn, J.R.; Benson, S.E. (Sandia National Labs., Livermore, CA). pp 1747-1753 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

Tube closure welds, commonly called pinch welds, are made by solid state upset welding, where quality assurance consists of process control and geometric feature verification. Ultrasonic nondestructive evaluation demonstrated the feasibility for sorting oxide contaminated pinch welds from clean welds. Until now contaminated pinch welds could only be detected by destructive testing. Two approaches are presented in this paper. First, a study was conducted to detect the variation in the ultrasonic signal caused by interaction with the pinch weld. Correlations between the good and bad welds were accomplished with feature extraction and pattern recognition techniques. The second approach involved high resolution scanning of the pinch weld with an acoustic microscope. The acoustic microscope produced excellent color images of the weld which clearly distinguished the pre-weld cleanliness.

37273 **Ultrasonic NDE of integrally fabricated turbine rotors.** Gray, T.A.; Thompson, R.B.; Margetan, F.J. (Iowa State Univ., Ames). pp 1763-1771 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

A new challenge to ultrasonic inspection techniques is the NDE of integrally fabricated turbine rotors, where the turbine blades are either bonded to the disk in the manufacturing process or during rotor repair. Although reliable detection of gross defects, such as significant disbonded areas, is certainly essential in bond NDE, this project is primarily concerned with the detection and characterization of overall bond quality from a microstructure perspective. Thus, recent efforts have been directed toward seeking various ultrasonic inspection techniques which show reliable and measurable correlation to near-bond microstructure variations and which are implementable as practical inspection configurations. Experiments have been performed both on bonded specimens from two major jet engine manufacturers and on a simulated bonded blade containing seeded defects in the bond plane. Inspection modes which showed the best promise of correlation to bond quality were leaky Rayleigh waves, critical angle longitudinal waves, and longitudinal wave inspection near grazing incidence to the bond plane. These methods also are, at least in principle, implementable as practical techniques since they only require access to a single side of the blade. A second area of effort concerned application of models of imperfect interfaces to the inference of bond microstructure parameters from ultrasonic scan data. Preliminary comparisons to experimental data were qualitatively favorable, but interpretation of model parameters in terms of the bond microstructure has not yet been possible. Results of the experimental tests are presented along with the preliminary model comparisons. Analysis of the results also concerns selection of candidate techniques for implementation in the second phase of this project.

37274 **Optical properties of iron and dilute iron-aluminum alloys.** Sexton, J.H. Ames, IA; Iowa State Univ. (1986). 99p. University Microfilms Order No. 87-03,765.Contract W-7405-ENG-82.

Thesis (Ph. D).

An interpolation scheme for the band structure of paramagnetic iron was used to model the band structure of ferromagnetic iron. This was carried out by superimposing two paramagnetic iron band structures with a 2.2 eV energy offset to simulate the exchange splitting. This model was used to calculate the optical conductivity of ferromagnetic iron. Good agreement was achieved between these results and the optical conductivity calculated from first principles by Callaway and Wang. This demonstrates the validity and the usefulness of an interpolation scheme for calculating quantities dependent on electronic structure. Composition modulation spectroscopy was applied to iron using aluminum as a diluent. Two characteristic features were present in the resulting $\Delta eta_2$ spectra. These were a broad negative peak at 2.5 eV and a broad positive peak at 6 eV - the same locations as the peaks in $\sigma_1$. The decrease in $eta_2$ at 2.5 eV is attributed to a depletion of electronic states in the host d bands. This depletion is mainly due to the valence difference between iron and aluminum. The increase in $eta_2$ at 6 eV is claimed to be due to band narrowing and/or the presence of a virtual bound state residing below the iron d bands.

37275 **Electron-tunneling studies of Mo/sub 1-x/Re/sub x/: enhancement of superconductivity by a resonance mode.** Shum, D.P.C. Ames, IA; Iowa State Univ. (1986). 108p. University Microfilms Order No. 87-03,769.Contract W-7405-ENG-82.

Thesis (Ph. D).

Sputtered thin films of bcc Mo/sub 1-x/Re/sub x/, $0.2 < x < 0.4$, were prepared for this study because the Re atom is almost twice as heavy as Mo. High-quality $MoRe/Al_2O_3/Pb$ tunnel junctions on these films were made with an in-situ deposited and subsequently oxidized thin Al layer as barrier. Three phonon peaks were observed directly in the dV/dI and $d^2V/dI^2$ curves. The $\alpha^2F(omega)$ spectra, determined from the data through the Eliash-

berg theory of superconductivity, all show an anomalous low-energy peak, in addition to the Mo-derived transverse and longitudinal phonon peaks. This peak appears near 14 meV, in agreement with the Brout-Visscher theory and with neutron scattering at which first indicated the Re resonance mode in Mo/sub .85/ Re/sub .15/. It is shown that the resonance mode contributes strongly to $\alpha^2$F(omega) and to strong coupling $\delta(=2\Delta/k/\text{sub B/T/sub c/} - 3.53) > 0$. $\delta$ increases with $\lambda$/sub R/, the Re contribution to the electron-phonon coupling constant $\lambda$. The dependences of the anomalous softening and width of the resonance mode on $\lambda$/sub R/ fit the Yu-Anderson theory of local phonon screening by a Fermi gas of electrons treated as Tomonago bosons. These results explain the low N(O), high T/sub c/ behavior of Mo/sub .6/Re/sub .4/.

37276 **Energy dissipation in the scanning tunneling microscopy of metals and insulators.** Flores, F.; Echenique, P.M.; Ritchie, R.H. (Departamento de Fisica del Estado Solido, Universidad Autonoma, Cantoblanco, 28049 Madrid). pp 122-124 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—).

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

Assisted tunneling processes in the metal-metal and metal-insulator interfaces is scanning tunneling microscopy are analyzed and compared with the normal current. The authors find that for high voltages, greater than 1 volt, tunneling processes can produce an important rise in temperature at the microscope's interface.

37277 **Tunneling from a self-energy approach.** Gras Marti, A.; Echenique, P.M.; Ritchie, R.H. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 339-342 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—).

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

Electron emission from a metal into the conduction band of a contiguous insulator is thought to be the precursor of breakdown under high electric fields. Such emissions is not well understood. The authors have studied this process in the simpler case of a metal-vacuum interface using a new self-energy approach.

## 3602 Ceramics, Cermets, And Refractories

*REFER ALSO TO CITATION(S) 37160, 37167, 37500*

37278 **(AD-A—179146/6/XAB) Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986.** Marshall, D.B.; Lange, F.F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jan 1987. 130p. (SC—5444-AR). NTIS, PC A07/MF A01.

In-situ optical observations during mechanical loading were used to investigate R-curve behavior in a series for transformation-toughened ceramics and to examine characteristics of the tetragonal-to-monoclinic transformation responsible for toughening. In high-strength and high-toughness materials, the strength is dictated by the R-curve and is independent of pre-existing flaws. The results explain observed strength-toughness relations in several zirconia systems (peak strength obtained at intermediate toughness) and are qualitatively consistent with predictions of fracture mechanics analysis of transformation toughening. Important insight into other microstructural influences of strength and toughness, and into factors that influence initiation and stabilization of the martensitic transformation were also obtained. Mechanisms of grain-growth control, critical for fabricating transformation toughened ceramics, in the two-phase region of the zirconium oxide/yttrium oxide system were investigated by measuring phase partitioning and microstructural development during sintering of a metastable precursor with a very-uniform initial distribution of $Y_2O_3$ additive. From the results it is suggested that partitioning begins with small compositional fluctuations between grains, and that strain energy resulting from lattic-parameter mismatch inhibits grain-boundary movement and hence grain growth. High-strength zirconia fibers were fabricated by drawing from an acetate precursor. The fibers had uniform diameters in the range 1-5 micrometers and, the compositions that exhibited grain-growth control, grain size < or = 0.2 micrometers, and strengths up to 2.6 GPa were obtained.

37279 **(AD-A—179167/2/XAB) Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Annual report, 1 March 1986-27 February 1987.** Kaufman, L. (Manlabs, Inc., Cambridge, MA (USA)). 27 Feb 1987. 38p. NTIS, PC A03/MF A01.

Computer-Coupled Phase Diagrams and Thermochemical Data were used to calculate the titanium dioxide-aluminum oxide, $TiO_2$-silicon dioxide, $TiO_2$-calcium oxide, $TiO_2$-yttrium oxide quasi-binary systems as well as ternary sections over a wide range of temperatures for the following systems: Hafnium oxide-Magnesium oxide-$Y_2O_3$, $HfO_2$-CaO-zirconium oxide, $SiO_2$-$HfO_2$-$Y_2O_3$, MgO-$SiO_2$-$HfO_2$, $TiO_2$-$Al_2O_3$-MgO, $Al_2O_3$-$TiO_2$-$SiO_2$, $TiO_2$-$Al_2O_3$-$HfO_2$ and MgO-$SiO_2$-$TiO_2$.

37280 **(AD-A—179671/3/XAB) Field dependence of geminate recombination in a dielectric medium. Final report, October 1974-September 1975.** Ausman, G.A. (Harry Diamond Labs., Adelphi, MD (USA)). Jan 1987. 20p. (HDL-TR—2097). NTIS, PC A02/MF A01.

The problem of recombination in insulators, especially thermally grown $SiO_2$, is an important part of the radiation response of microelectronic circuits. This report treats the geminate recombination process between an isolated electron-ion pair in the presence of an applied field. Specifically, the Onsager solution of the Smoluchowski equation was programmed for numerical computation. The program was applied to thermally grown $SiO_2$, and the results are presented as a function of applied field for several temperatures. A mean initial separation between negative and positive charges must be assumed, and the sensitivity of the result to this assumption is examined. The model results predict very little temperature dependence except at very low fields. These results will be compared with measurements in the future.

37281 **(CONF-851217—70) Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide.** Nixon, R.D.; Davis, R.F.; Bentley, J. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering; Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. Elseivier Science Publishing Co., Vanderbilt Ave., New York, NY 10017. File Number TI87011649.

From Materials Research Society meeting; Boston, MA, USA (2 Dec 1985).

Constant compressive stress creep experiments in the temperature and stress ranges of 1730K to 2100K and 16 MN/m$^2$ to 70 MN/m$^2$ on HIPed NbC/sub 0.74/ have revealed stress exponents of 2.0 under stress levels of 16 to 54 MN/m$^2$ at all temperatures investigated and 3.2 under stress levels of 54 to 70 MN/m$^2$ at 1830K. The activation energy of steady state creep is approximately 230 kJ/mol in the temperature range of 1730K to 1930K under 48 to 54 MN/m$^2$ and 470 kJ/mol in the temperature range of 1900K to 2100K under 64 MN/m$^2$. TEM of the annealed but uncrept material reveals grown-in dislocation subboundaries. At 1730K and under 34 to 54 MN/m$^2$ the subboundaries evolve into simple tilt boundaries which are occasionally knitted, indicating more glide activity at higher stresses. At 1930K and under 34 to 54 MN/m$^2$, hexagonal subboundaries form, but are not as well defined as in the annealed material. At 2100K and under 16 to 30 MN/m$^2$, the subboundaries are well-defined hexagonal networks which become polygonized under higher stresses on 64 MN/m$^2$. The experimental and TEM results indicate that at low temperatures (below 0.5 T/sub m/ = 2073K) and at all stresses, creep occurs by dislocation glide which is accompanied by subgrain and high angle boundary interaction. At high temperature (above 0.5 T/sub m/), strain occurs by glide and subboundary movement; recovery occurs by climb in the subboundary.

**37282 (CONF-860883—2) Production of fine, high-purity, beta SiC powder.** Shaffer, P.T.B.; Blakely, K.A.; Janney, M.A. (Advanced Refractory Technologies, Inc., Buffalo, NY (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010904.

From Ceramic powder science and technology; Boston, MA, USA (3 Aug 1986).

Each operation necessary to produce large quantities of submicrometer, high-purity $\beta$-SiC powder has been demonstrated and evaluated. By means of at least one process system, the economical, commercial production of $\beta$-SiC powder is assured. With the exception of the continuous high-temperature rotary furnace, the proposed process utilizes off-the-shelf technology and equipment. A parametric study was conducted on the effects of feed composition and furnace temperature on the degree of reaction, production rate, and crystalline size. Continuous furnace throughput rates of 500 kg/week were routinely demonstrated. Using inexpensive, readily available starting materials - silica and carbon black - the authors have shown that a finished powder having high purity (<100 ppM total cations) and high surface area in excess of 20 $m^2/g$ (equivalent to a mean spherical particle diameter of 0.09 $\mu$m) is routinely produced. Silica and free carbon levels of 0.2 wt % were demonstrated.

**37283 (CONF-860914—34) Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films.** Rudman, D.A.; Juang, J.Y.; van Dover, R.B.; Nakahara, S.; Capone, D.W. II; Talvacchio, J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering; Bell Labs., Murray Hill, NJ (USA); Argonne National Lab., IL (USA); Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jan 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87011403.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

The upper critical field of most polycrystalline NbN thin films is anisotropic, with the perpendicular critical field H/sub c2 (perpendicular) larger than the parallel critical field H/sub c2/(parallel). We have measured the angular dependence H/sub c2/($\theta$) for samples with both a columnar and non-columnar microstructure. In both cases we find a rounded maximum near H/sub c2/(perpendicular). The shape of H/sub c2/($\theta$), combined with the known microstructure of the films and the linear temperature dependence of H/sub c2/ for both field orientations leads us to conclude that the mechanism responsible for this anisotropy is an anisotropic conductivity in the film, probably due to differences in the grain boundary resistance in the plane of the film and normal to the film. In contrast, a single crystal film shows only surface superconductivity.

**37284 (CONF-870172—2) Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging.** Ellingson, W.A.; Ackerman, J.L.; Weyand, J.D.; DiMilia, R.A. (Argonne National Lab., IL (USA); Massachusetts General Hospital, Boston (USA); Aluminum Co. of America, Alcoa Center, PA). Jan 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011478.

From 11. annual conference on composites; Cocoa Beach, FL, USA (18 Jan 1987).

Characterizing advanced ceramics presents a challenge to conventional nondestructive evaluation techniques. Small bulk-density gradients, caused mainly by porosity differences, may lead to failure. Specimens were prepared from two $Al_2O_3$ powders with different particle size distributions. The specimens prepared from each powder ranged in density from as-pressed to nominally 90% TD. The relative porosity levels of the specimens were measured by a small-bore nuclear magnetic resonance (NMR) for characterizing open porosity in ceramic bodies.

**37285 (CONF-870172—4) NDE [nondestructive evaluation] and fracture studies of hot-pressed $Si_3N_4$.** Roberts, R.A.; Singh, J.P.; Vaitekunas, J.J. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011481.

From 11. annual conference on composites; Cocoa Beach, FL, USA (18 Jan 1987).

This paper presents recent correlations of nondestructive evaluation (NDE) and fractography results to establish the relative effectiveness of various NDE techniques in detecting and identifying failure-causing flaws in hot-pressed $Si_3N_4$. Ultrasonic and low-kV x-ray data are compared with fractography results by means of digital image-processing techniques.

**37286 (CONF-870388—12) AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process.** Kaufherr, N.; Fenske, G.R.; Busch, D.E.; Lin, P.; Deshpandey, C.; Bunshah, R.F. (Argonne National Lab., IL (USA); California Univ., Los Angeles (USA)). Mar 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011537.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

TiN/sub x/ and TiC/sub x/ films were deposited by the Activated Reactive Evaporation (ARE) process under different process conditions. The films were studied by Auger electron spectroscopy (AES) and Rutherford backscattering (RBS) and for both techniques standards were used. The low sensitivity of RBS to C and N employing 1.8 MeV $He^+$ ions was enhanced by using 1.5 MeV $H^+$ ions, but the resulting non-Rutherford scattering required the use of standards although RBS is potentially a standardless method. A correlation was found between the chemical composition of TiN/sub x/ and TiC/sub x/ films and the partial pressure of $N_2$ and $C_2H_2$, respectively.

**37287 (CONF-870438—27) Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials.** Capone, D.W. II; Flandermeyer, B. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011416.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The discovery of the $YBa_2Cu_3O_7$ high-T/sub c/ superconductor has sparked a tremendous interest, both in scientific and popular circles, in superconductivity applications at liquid nitrogen temperatures (65 to 77K). In this paper we present a summary of the present status of the conductor development program at Argonne and point out those areas where short-term effort will be expended in order to improve the critical current densities of these materials.

**37288 (CONF-870438—28) Transport critical-current characteristics of $Y_1Ba_2Cu_3O$/sub x/.** Ekin, J.W.; Panson, A.J.; Braginski, A.I.; Janocko, M.A.; Hong, M.; Kwo, J.; Liou, S.H.; Capone, D.W.; Flandermeyer, B. (National Bureau of Standards, Boulder, CO (USA); Westinghouse Research and Development Center, Pittsburgh, PA (USA); Bell Labs., Murray Hill, NJ (USA); Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011525.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Voltage vs current (V-I) characteristics were measured at magnetic fields up to 24 T at a temperature of 77°K in several $Y_1Ba_2Cu_3O$/sub x/ samples fabricated at different laboratories. All the samples showed linear V-I characteristics at current levels exceeding the critical current. The slope of the V-I characteristic in this region increased with magnetic field, with fields greater than 24 T required to reach the normal resistance value at T/sub c/. Values of the transport critical-current density J/sub c/ in zero magnetic field were generally low and variable (about 1 to 200 $A/cm^2$). The transport J/sub c/ fell sharply when magnetic field was applied, decreasing by about an order of magnitude between 0 and 1 T. This leads to an effective upper critical field for transport critical currents in $Y_1Ba_2Cu_3O$/sub x/ that is significantly less than the upper critical field defined by where the resistance increases to the normal value.

37289 **(CONF-870862—1) Antiphase boundaries in β-SiC thin films.** More, K.L.; Bentley, J.; Davis, R.F. (Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA); North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009133.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Beta-SiC thin films are currently being grown via chemical vapor deposition (CVD) for potential use as a semiconductor material. As a result of the lattice mismatch between the silicon and β-SiC, a high density of defects, predominantly microtwins and stacking faults, are present at the Si-SiC interface. The density of these defects decreases with increasing distance from the interface. As shown in the weak-beam dark-field (WBDF) micrograph, the "boundaries" are irregular and wind throughout the film interacting with stacking faults and other defects present. The nomenclature of APB is misleading, especially compared to many ordered intermetallic alloys where the displacement vector associated with the APB is a lattice translation that interchanges atomic species. Clearly the displacement vector is not a/4[111] and furthermore the conventional g.R analysis is inapplicable, although apparent "invisibilities" are observed. Convergent beam electron diffraction has been used to demonstrate the polarity change. We have confirmed this effect.

37290 **(CONF-870862—6) Electron microscopy of high temperature oxide superconductors.** Bentley, J.; Fisher, A.T.; Haltom, C.P.; Brynestad, J.; Lauf, R.J.; Williams, R.K.; Kroeger, D.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009132.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Structures of La/sub 1.85/ Sr/sub 0.15/ $CuO_4$ and Y-Ba-Cu-O oxides were studied. (DLC)

37291 **(CONF-870873—3) Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/$CuO_4$.** Christen, D.K.; Thompson, J.R.; Sekula, S.T.; Boatner, L.A.; Sales, B.C.; Pennycook, S.J. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. File Number DE87009825.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

For various thermal processing conditions, measurements of the electrical transport and superconducting magnetic properties have been correlated with the microstructure as determined by x-ray diffraction and transmission electron microscopy. We find the largest critical current densities J/sub c/ are associated with the presence of coherent second-phase precipitates, and are significantly higher than for materials containing only grain boundaries or dislocations as flux pinning sites. Low-temperature annealing in oxygen results in nearly perfect, defect-free grains, separated by clean, planar grain boundaries. We conclude that the temperature-dependent diamagnetic response below T/sub c/ cannot be explained by the observed gross microstructure.

37292 **(CONF-8705103—6) Effect of flaws on the fracture behavior of structural ceramics.** Singh, J.P.; Roberts, R.A.; Vaitekunas, J.J.; Ellingson, W.A. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011432.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

Fracture studies and nondestructive evaluation (NDE) were performed to detect and assess the effect of flaws on the fracture behavior of hot-pressed $Si_3N_4$ with Fe inclusions. The NDE methods used were through-transmission and backscatter ultrasound and low-kV contact radiography. The addition of 5 and 0.5 wt % Fe inclusions of 88 to 250 μm size reduced the strength of $Si_3N_4$ specimens by approximately 40 and 15%, respectively. Fractography indicated that failure occurred primarily from internal flaws which included Fe- and Si-rich inclusions and/or regions of $Si_3N_4$ matrix that were degraded as a result of reaction between $Si_3N_4$ and molten Fe. For Fe inclusion-induced internal flaws, the critical flaw sizes calculated by fracture mechanics were always larger than the fractographically measured flaw sizes. This observation suggested a local degradation in fracture toughness of $Si_3N_4$ matrix. A ratio, K, of ~3.5 to 4.2 appeared to exist between the calculated and measured values of the critical internal flaw sizes. The ratio K will have important implications for strength prediction based on observed flaw size. A comparison of the fractography and NDE results for the location of critical flaws indicated that the backscatter ultrasound method may be more suitable than through-transmission ultrasound or low-kV contact radiography for the detection of near-surface flaws.

37293 **(CONF-8705103—7) Materials development for solid oxide oxygen production unit.** Easler, T.E.; Poeppel, R.B. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011450.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

The implementation of a solid oxide oxygen pump in coal gasification systems is believed to have the potential for significantly reducing the cost of oxygen generation for the gasification process. The solid oxide oxygen pump concept is based on the oxygen-ion conducting behavior of zirconia ceramics. The approach being taken to fabricate the oxygen pump involves fabrication of thin multilayer structures of ceramic electrode and electrolyte materials by the tape casting process. It is desired to make the laminated structures as thin as possible to minimize internal power losses which are the result of the high resistances of the individual ceramic oxide layers. Both the air and oxygen electrodes are made of strontium-doped lanthanum manganite. The particular ceramic electrolyte under development in this project is zirconia doped with 8 mol % $Y_2O_3$. This study is particularly concerned with determining the types of failure modes that may be associated with the very thin ceramic layers. The fabrication of the layers, and the initial failure mode identification tests, are described in this paper.

37294 **(CONF-8706125—3-Draft) Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/.** Thompson, J.R.; Christen, D.K.; Sekula, S.T.; Brynestad, J.; Kim, Y.C. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). Jun 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011684.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

The superconductive state magnetization of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/ has been investigated. Single phase, polycrystalline samples of this archetype were prepared by solid state reaction. The onset of the superconductive transition, measured magnetically, was 90.7°K. In addition to low field dc magnetization results, measurements of the magnetic critical current density J/sub c/(H,T) are presented as a function of magnetic field and temperature. The low values of J/sub c/, especially at high temperature, are discussed in terms of interganular supercurrents which flow within individual grains in superconductive layers of reduced dimensionality.

37295 **(DOE/CE/90001—1) The joint effect of surface microtopography and near-surface structure on microcontact conditions: Quarterly progress report for period 31 March 1987 to 30 June 1987.** McCool, J.I. (SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics). Jun 1987. Contract AC02-87CE90001. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011335.

Key issues raised at a program review meeting are discussed and consequent revisions in approach are described. The calculation of expected contact size is considered and shown to be relatively insensitive to the separation of the contacting surfaces. It is shown that a microcontact analysis in which various asperity types are present in specified proportions may be carried out simply by using the mean modified Young's modulus in lieu of the value applicable for the case of single asperity types. The analysis presupposes that the microgeometry is not a function of asperity types.

37296 **(DOE/ER/13163—14) Mechanical interactions of rough surfaces: Quarterly progress report for period December 31, 1986 to March 29, 1987.** McCool, J.I. (SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics). Mar 1987. Contract AC02-84ER13163. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011341.

Static and rolling contact experiments were conducted with silicon nitride (NC-132) in an effort to determine the character of surface asperity response (plastic flow and/or fracture) to combined normal and tangential stress. Preliminary observations show evidence of fracture along the shoulders of grinding ridges. Also, a significant amount of plastic flow can be accommodated without fracture under the localized compressively stressed areas within the contact.

37297 **(EPRI-EM—5274) Reliability of silicon carbide in combustion environments: Final report.** Tsai, Y.; Tressler, R.E.; Near, C. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 111p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920485.

In laboratory tests, apparent strengthening occurred when coarse-grained silicon carbide containing 10 to 15% silicon was stressed above 65% of its fracture stress at 1300°C for 4 to 50h. The strength increase was attributable to flaw blunting and macroscopic stress redistribution.

37298 **(KFK—4173) Quantitative microstructural effects on the conductivity of composites.** Ondracek, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Nov 1986. 11p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-04529.

Theoretically two types of equations exist treating the correlation between microstructure and conductivity of two-phase materials: the bound equations and the constitutive microstructure-field property equations. It depends on the available information about the materials microstructure which type of equation has to be used for the conductivity calculation. This is demonstrated for ceramic-metal-, metal-polymer- and polymer-ceramic-composites. Their measured conductivities are compared with calculated values.

37299 **(KFK—4174) Porosity and thermal shock behaviour of ceramic materials.** Jauch, U.; Ondracek, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Nov 1986. 5p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-04742.

Considering theoretical porosity-property-correlations a porosity dependence of the thermal shock resistance of ceramics is discussed. The treatment demonstrates, that low porosity may lead to an increase in the thermal shock resistance.

37300 **(LA-UR—87-1673) Whisker reinforced structural ceramics: Progress in the VLS growth and use of long silicon carbide whiskers.** Gac, F.D.; Shalek, P.D.; Parkinson, W.J.; Edwards, C.; Price, J.B. (Los Alamos National Lab., NM (USA); Texas Tech Univ., Lubbock (USA). Textile Research Center). 1987. Contract W-7405-ENG-36. 22p. (CONF-8705103—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011066.

From Fossil energy materials program conference; Oak Ridge, TN, USA (19 May 1987).

A VLS (vapor-liquid-solid) whisker growth process, optimized for the production of short (~10 mm lengths) SiC whiskers, was modified to produce ≧ 25 mm long whiskers. In conjunction with this modification, a plan was developed for incorporating an artificial-intelligence system to enhance the whisker growth process. An oriented whisker ribbon was produced from the long whiskers, as a step toward the development of a staple whisker yarn.

37301 **(ORNL/TM—10403) Effect of infiltration conditions on the properties of SiC/Nicalon composites.** Lowden, R.A.; Caputo, A.J.; Stinton, D.P.; Besmann, T.M.; Morris, M.D. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011948.

A statistically designed experiment was performed to evaluate the effects of process variables on fiber-reinforced SiC composites fabricated by chemical vapor infiltration. Response surface methodology was applied to study the influence of temperature, pressure, reactant supply rate, and gas ratios on the deposition process and the properties of the produced material. Deposition temperature and total gas flow rates had inverse effects on density and strength, while the effect of pressure was statistically insignificant. Low $H_2$:$CH_3SiCl_3$ ratios evoked a positive response in all dependent variables. 42 refs., 7 figs., 4 tabs.

37302 **(PNL-SA—14497) PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass.** Schilling, C.H.; Lee, M.C. (Pacific Northwest Lab., Richland, WA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1986. Contract AC06-76RL01830. 9p. (CONF-861207—109). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011337.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Seventy wt% PbO . 30 wt% $B_2O_3$ glass was melted in Pt and graphite crucibles; PbO reduction and subsequent crucible reactions were empirically investigated as a function of temperature and oxygen partial pressure. This research was conducted at NASA to determine optimum processing conditions for subcentimeter glass hollow spheres to be used as inertial confinement fusion targets for a particle beam fusion accelerator at Sandia National Laboratories. The research enables selection of appropriate crucible materials and oxygen partial pressure-temperature combinations necessary to avoid phase separation from PbO reduction and/or crucible reactions. Phase separation from PbO reduction was not detected in glass samples melted in Pt crucibles under oxidizing atmospheres. Under reducing atmospheres from mechanical and diffusion pump vacuum, oxygen gas emissions were detected along with Pb-Pt compounds forming on Pt crucibles. With graphite crucibles, glasses contained lead-rich phases and $CO_2$ gas bubbles. Experimental results were compared with the theoretical Pb-PbO stability boundary predicted on the basis of the standard free energy change of PbO reduction.

37303 **(PNL-SA—14744) Ceramic thermal barrier coatings with improved corrosion resistance.** Prater, J.T.; Courtright, E.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 6p. (CONF-870388—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011145.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

A method for limiting the ingress of corrosive species into physical vapor deposited zirconia thermal barrier coatings by inserting dense ceramic sealing layers into the usual columnar (segmented) ceramic microstructure has been examined. The concept was evaluated by sputtering a series of $ZrO_2$-$2OY_2O_3$ deposits onto In792 substrates coated with a CoCrAlY bondlayer.

37304 **(SAND—86-2750C) Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides.** Emin, D.; Howard, I.A.; Green, T.A.; Beckel, C.L. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy). 1987. Contract AC04-76DP00789. 7p. (CONF-870438—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009060.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Large grain polycrystalline boron carbides have a high-temperature thermal conductivity which changes from being characteristic of a crystal to being glass-like as the carbon content is reduced from its maximal value. We related this phenomenon, to compositional changes within the three-atom intericosahedral chains. With a reduction of the carbon concentration from its maximal concentra-

tion (20%), a carbon atom within some of the three-atom (CBC) intericosahedral chains is replaced by a boron atom thereby producing CBB chains. We estimate that the CBB chains are significantly softer than the CBC chains. Thus, with this reduction of carbon content the intericosahedral chains are inhomogeneously softened. This suppresses the coherent transport of heat through the chains. The remaining thermal transport occurs incoherently through vibrationally inequivalent structural units, i.e. "phonon hopping."

37305 **Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$.** Schirber, J.E.; Venturini, E.L.; Kwak, J.F.; Ginley, D.S.; Morosin, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Materials Research;* 2: No. 4, 421-423(Jul 1987). Contract AC04-76DP00789.

Hydrostatic pressure measurements of the superconducting transition temperature were made as a function of x in La/sub 2-// sub x/Sr/sub x/$CuO_4$. A sharp change in the behavior occurs between x = 0.2 and 0.25 in that the pressure derivative goes from positive to essentially zero. This result is discussed in the context of band structure models.

37306 **Deformation of polycrystalline $Li_2O$.** Goretta, K.C.; Applegate, D.S.; Poeppel, R.B.; Billone, M.C.; Routbort, J.L. (Argonne National Lab., IL). *Journal of Nuclear Materials;* 148: No. 2, 166-170(Apr 1987). Contract W-31-109-ENG-38.

Constant-crosshead-speed compression of $Li_2O$ polycrystals has been performed at temperatures of 700-950°C with strain rates ranging from about $10^{-6}$-$10^{-4}$ $s^{-1}$. For temperatures greater than 850°C, data suggest deformation rates are controlled by recovery via dislocation climb. For lower temperatures, impurity effects may alter the deformation mechanism. At 950°C, viscous creep occurs at low strain rates. For porosities ranging from about 7 to 21%, deformation is strongly dependent on porosity, but is virtually independent of grain size.

37307 **Ultrasonic NDE of green-state ceramics by focused through-transmission.** Roberts, R.A. (Argonne National Lab., IL). pp 1443-1452 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

Past work in the application of ultrasonic NDE to green-state ceramics has been hampered by the lack of an efficient yet safe means to obtain ultrasonic coupling, since conventional coupling fluids (water, gels, oils, etc.) have a detrimental effect on fragile green-state materials. In early work, direct contact pressure was used to obtain dry coupling between transducer and specimen. This approach was later improved upon by placing an elastomer membrane between the transducer and specimen; this method provided efficient coupling at significantly lower contact pressures. In the study presented here, an acoustically transparent plastic membrane was held against the ceramic specimen by atmospheric pressure. The advantage of this technique is that it allows the use of ultrasonic immersion techniques as well as contact transducers. Another impediment to ultrasonic measurement in green-state ceramics is the extreme attenuation inherent in the compacted powder specimens. Owing to this attenuation, previous work has been limited to the measurement of bulk material properties (density, elasticity, agglomeration, etc.). In contrast, this paper discusses the potential for detecting isolated inclusions and regional inhomogeneities in material parameters by using focused ultrasound fields.

37308 **Preparation of Al/sub 2/O/sub 3/-ZrO/sub 2/ composites by adjustment of surface chemical behavior.** Baik, S.; Bleier, A.; Becher, P.F. (Oak Ridge National Lab., Oak Ridge, TN). pp 791-800 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC05-84OR21400.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Aqueous colloidal routes for processing binary suspensions containing Al/sub 2/O/sub 3/ and ZrO/sub 2/ were designed and tested in order to achieve homogeneous microstructures. Effects of particle size and size ratio of each component, pH, and electrolyte concentration of composite suspensions on sedimentation, green density, and ZrO/sub 2/ distribution in sintered microstructures were examined. The pH conditions for inhibiting differential sedimentation without impairing green density were optimized. Overall suspension and coagulation behavior for these composite systems were explained using the DLVO approach.

37309 **The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films.** Budd, K.D.; Dey, S.K.; Payne, D.A. (Univ. of Illinois at Urbana-Champaign, Urbana, IL). pp 711-716 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Sol-gel processing represents a promising method of fabrication for thin films of electronic ceramics which are useful in a number of packaging and device applications. In this study, the influence of acid and base catalysts on the structure of PbTiO/sub 3/ gels and films (0.1-1.0 μm) was investigated, for the purpose of inducing and identifying gel structures which were the most suitable as precursors for thin dielectric layers. Continuous, crack-free films, with dielectric strengths in excess of 10/sup 6/ V/cm were developed. Basic solutions gelled rapidly, phase separated, and were probably more crosslinked than acidic gels. Acidic gels seemed more capable of polymeric rearrangement during drying, yielding denser amorphous structures with microcrystalline regions.

37310 **Precipitation kinetics of the titanium isopropoxide hydrolysis reaction.** Hartel, R.W.; Berglund, K.A. (Michigan State Univ., East Lansing, MI). pp 633-640 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The precipitation product of the titanium isopropoxide (TiPT) hydrolysis reaction was followed using photon correlation spectroscopy. This technique followed the mean size of the precipitate as the reaction progressed, as well as giving an indication of the number of particles being produced. From this analysis, the induction time for the onset of nucleation, nucleation rate (or the rate of particle production) and mean growth rate were correlated with reactant concentrations. In the concentration ranges studied, it was found that the induction time was a very strong inverse function of the reactant concentrations. Both nucleation rate and average growth rate were found to increase very rapidly as reactant concentration increased, with the TiPT concentration being more important. This reaction was also followed using absorbance spectrophotometry in the 500 to 320 nm range.

37311 **Precursors of titanium carbonitride.** Maya, L. (Oak Ridge National Lab., Oak Ridge, TN). pp 401-406 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC05-84OR21400.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

A series of novel compounds was isolated in the course of exploratory work on the chemistry of titanium halides in liquid ammonia. This work was undertaken to study synthetic approaches to titanium-containing precursors of ceramic materials. Representative of these compounds is a mixed valence Ti(III)-Ti(IV) tetramer, [NH/sub 4//sup +/ . NH/sub 3/]/sub 2/[Ti/sub 4/Br/sub 4/(NH/sub 2/)/sub 12/]/sup -2/, which was produced by the reaction of potassium borohydride and titanium IV bromide in liquid ammonia at room temperature. Similar ammonium salts of either Ti(IV) or Ti(III) were also prepared. The reaction of the ammonium salts with sodium acetylide in liquid ammonia evolves acetylene in an amount equivalent to the ammonium ion present. This provided the

charge of the complex and yielded novel titanium acetylide derivatives. The acetylides convert into titanium carbonitrides upon thermal treatment to 800°C.

37312 **Kinetic investigations of alkoxysilane sol-gel processing.** Hardman-Rhyne, K.A.; Coyle, T.D.; Lewis, E.P.; Spooner, S. (NBS, Gaithersburg, MD). pp 173-178 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Effective control of sol-gel glass processing requires a detailed understanding of the kinetic and mechanistic aspects of the process. The authors have investigated structural evolution at the molecular level in the tetramethoxysilane (TMOS) hydrolysis reaction by various spectroscopic techniques. Development of structure at the macromolecular level and evolution of particle/network dimensionality have been studied by small-angle x-ray scattering (SAXS) in both hydrogenated and fully deuterated reactions for silica macromolecular structural development.

37313 **High field /sup 1/H NMR studies of sol-gel kinetics.** Kay, B.D.; Assink, R.A. (Sandia National Labs., Albuquerque, NM). pp 157-164 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

High resolution /sup 1/H NMR spectroscopy at high magnetic fields is employed to study the reaction kinetics of the Si(OCH/sub 3/)/sub 4/:CH/sub 3/OH:H/sub 2/O sol-gel system. Both the overall extent of reaction as a function of time and the equilibrium distribution of species are measured. In acid catalyzed solution, condensation is the rate limiting step while in base catalyzed solution, hydrolysis becomes rate limiting. A kinetic model in which the rate of hydrolysis is assumed to be independent of the adjacent functional groups is presented. This model correctly predicts the distribution of product species during the initial stages of the sol-gel reaction.

37314 **Precipitation of PZT and PLZT powders using a continuous reactor.** Schwartz, R.W.; Eichorst, D.J.; Payne, D.A. (Univ. of Illinois at Urbana-Champaign, Urbana, IL). pp 123-128 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

PZT and PLZT powders were prepared from nitrate and chloride percursors in a continuous constant volume precipitator. After precipitation, the powders were dried by a variety of methods, including: spray-drying, freeze-drying (in liquid nitrogen), and centrifugal freeze-drying. Spray-dried powders were found to have a spherical morphology, and to be solid. The particle size was in the micron range. Powders dried by nitrogen freeze-drying were characterized by an open morphology of agglomerated platelets. For centrifugally freeze-dried powders, particle size analyses were found to fit a population balance model, giving crystallite, cluster, and agglomerate population densities and growth rates.

37315 **Nucleation and growth of uniform m-ZRO/sub 2/.** Bleier, A.; Cannon, R.M. (Oak Ridge National Lab., Oak Ridge, TN). pp 71-78 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC05-84OR21400.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Hydrothermal treatment of zirconyl salt solutions produces uniform m-ZrO/sub 2/ powder on the order of 80 nm. This powder is porous, has a 3-nm crystallite size, and exhibits an unusually high degree of crystallographic alignment within particles. The generation of this powder occurs via a complex process involving nucleation, growth, and controlled agglomeration of primary particles. Particle formation, crystallographic alignment and particulate uniformity are explained in terms of solution reactions and colloidal behavior.

37316 **Polymer growth and gelation in borate-based systems.** Brinker, C.J.; Ward, K.J.; Keefer, K.D.; Holupka, E.; Bray, P.J. (Sandia National Labs., Albuquerque, NM). pp 57-70 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

In situ FTIR, NMR and SAXS were used to investigate the synthesis and molecular structure of xLi/sub 2/O . (1-x)B/sub 2/O/sub 3/ gels derived from tri-n-butyl borate (TBB) and lithium methoxide. In solution the fraction of tetrahedrally coordinated borons (N/sub 4/) increases linearly with x, and a critical value of N/sub 4/ must be exceeded in order to form gels. The primary criterion affecting gel formation is the kinetic stability of borate bonds toward molecules which are able to undergo dissociative chemisorption.

37317 **Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions.** Balfe, C.A.; Martinez, S.L. (Sandia National Labs., Albuquerque, NM). pp 27-34 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Silicon-29 NMR has been used to investigate the initial steps of hydrolysis and condensation of tetramethoxysilane (TMOS), hexamethoxydisiloxane, and octamethoxytrisiloxane in both basic and acidic methanol solutions. Comparisons of the spectra obtained from the various starting solutions and literature reports of mono-, di-, and tri-silicic acids in aqueous solution were used to identify and assign chemical shifts to condensation intermediates in the TMOS system. The observation of cyclic intermediates in the acid catalysis of TMOS in methanol and the chemical shifts of several products of its hydrolysis and condensation are reported.

37318 **A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors.** Klemperer, W.G.; Mainz, V.V.; Millar, D.M. (Univ. of Illinois, Urbana, IL). pp 15-26 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

A solid state multinuclear NMR study of the sol-gel process was performed using the molecular building blocks tetramethoxysilane, hexamethoxydisiloxane, octamethoxytrisiloxane and octamethoxyoctasilsesquioxane as precursor monomers. Water content, solvent content, and hydrolysis/condensation processes were monitored using /sup 17/O, /sup 13/C, and /sup 29/Si FT, FTMAS and CPMAS NMR techniques.

37319 **A molecular building-block approach to the synthesis of ceramic materials.** Klemperer, W.G.; Mainz, V.V.; Millar, D.M. (Univ. of Illinois, Urbana, IL). pp 3-14 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Ceramic materials are generally prepared from structurally simple starting materials, with the consequence that structural properties are difficult to control on a molecular level. This difficulty might be addressed by following the approach taken in polymer chemistry in which molecular building blocks are first prepared and then polymerized in a subsequent step. In the present case, the polysilicic acid esters [Si/sub 2/O]-(OCH/sub 3/)/sub 6/, [Si/sub 3/O/sub 2/](OCH/sub 3/)/sub 8/, and [Si/sub 8/O/sub 12/](OCH/sub 3/)/sub 8/ are prepared and then polymerized by hydrolysis/

condensation. Silicon-29 solution nuclear magnetic resonance (NMR) spectroscopy is used to estimate the extent to which the molecular frameworks of these monomers are retained during the course of hydrolysis and condensation.

37320 **Zirconia characterization by perturbed angular correlation spectroscopy.** Jaeger, H.; Gardner, J.A.; Haygarth, J.C.; Rasera, R.L. (Oregon State Univ., Corvallis, OR). pp 599-604 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Perturbed Angular Correlation spectroscopy of /sup 181/Ta nuclei occupying cation sites has been used to investigate microscopic structural properties of several pure and stabilized zirconia materials. The PAC spectra are used to derive the electric field gradients at the tracer nucleus. These are compared with calculations based on a simple point-ion model. Agreement between experiment and theory is good for stabilized material and qualitatively reasonable for pure zirconia.

37321 **Fractal aspects of ceramic synthesis.** Schaefer, D.W.; Keefer, K.D. (Sandia National Labs., Albuquerque, NM). pp 277-288 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The concept of fractal geometry is used to describe the structure of silica polymers, colloidal aggregates, and critical systems. The authors illustrate the interpretation of scatte..ng curves (X-ray, neutron and light) for fractal systems, and review simple growth models which generate fractal structures. They describe the polymerization of silica under various conditions and demonstrate that, depending on chemical conditions, polymerization maps onto simple fractal growth processes. The key factors which control growth are monomer-cluster vs. cluster-cluster growth, and reaction-limited vs. diffusion-limited growth.

37322 **Microstructural studies of transparent silica gels and aerogels.** Tewari, P.H.; Hunt, A.J.; Lofftus, K.D.; Lieber, J.G. (Lawrence Berkeley Lab., Berkeley, CA). pp 195-206 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC03-76SF00098.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Transmission electron microscopy, spectroscopy, light scattering and surface area measurements have been used to characterize the microstructural details of transparent silica aerogels. Light scattering intensity measurements have also been used to differentiate acid and base catalyzed hydrolysis and condensation reaction kinetics of Si(OC/sub 2/H/sub 5/)/sub 4/. A plot of logarithm of the light scattering intensity vs. logarithm of time during gelation gives distinctly different slopers for acid and base catalyzed systems (6 for acid and 2 for base). These slopes for the two systems can be explained on the basis of the point of zero charge of silica and the resulting interactions of the uncharged and charged particles in the systems.

37323 **Solution chemistry of silicate and borate materials.** Bunker, B.C. (Sandia National Labs., Albuquerque, NM). pp 49-56 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Reactions which create and destroy Si-O-Si, Si-O-B, and B-O-B bonds occur in leached layers on borosilicate glasses during glass dissolution. Solid state NMR, Raman, and TEM techniques have been used to determine the distribution of species formed in leached layers as a function of solution pH and the mechanisms of glass-water reactions. The chemical principles which govern the reactivity of silicate and borate bonds in leached layers appear to be similar to those which govern the formation of silicate and borate gels via sol-gel techniques.

## 3606 Other Materials

*REFER ALSO TO CITATION(S) 36503, 36634, 36635, 36673, 36771, 37200, 37239, 37254, 37298, 37430, 37514, 37516, 37517*

37324 **(AD-A—179109/4/XAB) Material damping measurements of 2-d carbon-carbon composite beams. Master's thesis.** Muller, E.S. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 117p. (AFIT/GAE/AA—86D-10). NTIS, PC A06/MF A01.

Current work in thermal-protective materials for space systems and advanced jet engines are investigating the use of an advanced carbon-carbon composite material (ACCM) to build critical components that must operate in very-high-temperature regimes. The potential use of ACCM in these applications must address the problems of vibration that might occur during system operations. Vibrations can cause severe performance degradations, if not controlled. One method of control, called passive damping, relies on the material's inherent damping characteristics. This study evaluates ACCM's damping characteristics, important to passive damping understanding. Modal-analysis techniques using an impact hammer to excite sinuseidal free vibration were used to find the damping natural frequencies for 2-D ACCM beams. The logarithmic-decrement technique was applied to the fundamental modes to verify the frequency and damping data derived by the modal analysis. Additionally, the logarithmic-decrement technique was used to evaluate atmopheric-drag influences on damping. It was shown that for small amplitudes, less than the beam's thickness, the damping effects of atmospheric drag were minimized and considered negligible. Cantilevered-beam specimens were studied for the first three modes in test conditions at room temperature and atmospheric pressure.

37325 **(AD-A—179134/2/XAB) Superconducting electronic-film structures. Annual report, 1 January-31 December 1986.** Braginski, A.I.; Gavaler, J.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 20 Jan 1987. 24p. NTIS, PC A02/MF A01.

Bulk samples of the newly discovered La-Sr-Cu-O superconductors were made that have critical onset temperatures over 38 K. The greater effectiveness of impurities (oxygen) compared to epitaxy for the stabilization of stoichiometric A15 Nb-Ge was demonstrated. The positive effect of oxides on the formation of A15 Nb-Al was also shown. Experiments involving the deliberate addition of a contaminant (methane) during barrier deposition provided a major advance in the understanding of the processes required for producing high-quality NbN-MgO-NbN junctions. A model for predicting the orientation of single-crystal Nb and Nb-Sn films on sapphire was experimentally verified. Results obtained indicate that epitaxy is essential for NbN-MgO-NbN trilayer processing if the junction is to be operated above 4.2 K.

37326 **(AD-A—179214/2/XAB) Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis.** Kelley, W.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 114p. (AFIT/GAE/AA—86D-6). NTIS, PC A06/MF A01.

The influence of the addition of silicon carbide (SiC) whiskers and zirconia on the material properties and constants of pure mullite was examined. SiC whisker weight percentages of 0, 10, 20, and 30 were examined, and a zirconia content of 36.1 wt.% was studied. A theoretical approach similar to Hasselman's high-E, low-E theory was used to determine the theoretical values of the material properties, which were then compared to experimental results. Using experimental and theoretical values for Young's modulus of elasticity, bend strength, mean coefficient of thermal expansion, thermal diffusivity, and Poisson's ratio, the thermal-stress-resistance parameters were calculated, and compared to experimental results for critical quench temperatures. Microstructures were characterized by x-ray diffraction (XRD) analysis, chemical analysis, density determinations, light microscopy (LM), and scanning electron mi-

croscopy (SEM). The mullite was alumina-rich with particles of silica present. Whisker composites contained 2H, 4H, and 15R polytypes of SiC and impurities from the whisker. Mullite-zirconia microstructures contained partially-stabilized zirconia with monoclinic:tetragonal ratios of 90%. Increasing SiC whisker content decreased the Poisson's ratio and mean coefficient of thermal expansion of the specimen and increased the elastic modulus, bend strength, and thermal diffusivity of the composites.

37327 **(AD-A—179232/4/XAB) Photoluminescence study of germanium-implanted gallium arsenide. Master's thesis.** Thoma, B.P. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1985. 85p. (AFIT/GEP/ENP—86D-11). NTISMF A01.

Availability: Microfiche copies only.

The low-temperature photoluminescence properties of Ge-implanted GaAs was analyzed. Samples were singly implanted with Ge and As, and with Ge and Ga. The substrate used was semi-insulating chromium-doped GaAs. All ions were implanted at room temperature, with an implantation energy of 120 keV. Dually implanted samples were first implanted with Ge, and then with either As or Ga. All samples were encapsulated before annealing with approximately 1000 A of silicon nitride, which was subsequently removed prior to photoluminescence measurements. All samples were annealed at 900 C for 15 minutes. Two separate photoluminescence peaks related to Ge acceptors were found. They were due to a Ge donor-Ge acceptor transition and a conduction band-Ge acceptor transition. A single photoluminescence peak related to Ge donors was found. It was due to an exciton bound to a neutral donor or an ionized donor transition. Ge acceptor related peaks were found to be dominant in lower-dose Ge-implanted samples, and the Ge-donor-related peak was found to be dominant in higher-dose Ge-implanted samples. These characteristics were significantly modified, however, by the dual implantations. The Ge donor related peak was enhanced, and the Ge acceptor-related peaks were suppressed, by the additional As implantation. To a lesser extent, the opposite was true for the additional Ga implantation.

37328 **(BNL—39924) Magnetism of MnSi and FeSi.** Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 6p. (CONF-8705156—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012123.

From Workshop on magnetic excitations and fluctuations II; Torino, Italy (23 May 1987).

A review is presented of neutron scattering studies of isostructural MnSi and FeSi. MnSi exhibits typical characteristics of an itinerant electron ferromagnet. On the other hand, FeSi is a unique example of temperature-induced magnetism through a narrow band gap.

37329 **(CCMS—6-08) Mechanical and thermal characterization of unidirectional aramid/epoxy. Final report, November 1985-December 1986.** Pindera, M.J.; Gurdal, Z.; Hidde, J.S.; Herakovich, C.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Feb 1987. 247p. (VPI—86-29). NTIS, PC A11/MF A01.

The results of an extensive experimental investigation of the mechanical and thermal response of an aramid/epoxy unidirectional composite which is one of the constituents of currently produced ARALL laminates were summarized. The characterization of mechanical response of the supplied aramid/epoxy system was performed at room temperature. Three different test methods were employed: the off-axis tension test, the Losipescu shear test, and the off-axis compression test. All tests were performed under monotonic and quasi-cyclic loading conditions in order to determine the initial elastic response and subsequent nonlinear response, including permanent strain accumulation as a function of the stress reversal level and failure. The results of the tests were summarized.

37330 **(CEA-CONF—8619) Exafs and neutron scattering determination of local order in a-Si:H.** Menelle, A.; Bellissent, R. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1986. 5p. (CEA-DPh-G-LLB-SDN—86-34; CONF-860892—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751790.

From 18. international conference on physics of semiconductors; Stockholm, Sweden (11 Aug 1986).

Short and medium range order of a-Si and a-Si:H have been investigated using EXAFS and neutron scattering. A structural model for amorphous silicon is proposed.

37331 **(CONF-8706151—1-Draft) Structural nature of the amorphous-to-crystalline transition in phosphate glasses as studied by liquid chromatography.** Sales, B.C.; Ramey, J.O.; Boatner, L.A. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02. File Number DE87011208.

From 2. international conference on the effects of modes of formation on the structure of glasses; Nashville, TN, USA (16 Jun 1987).

The technique of high performance liquid chromatography (HPLC) has been used to study the structural changes that occur during the isothermal amorphous-to-crystalline transition of lead pyrophosphate glass. The evolution with time of the basis structural units of the material (i.e., individual phosphate anions) during the devitrification process was determined using the HPLC at temperatures below, at, and above the glass transition.

37332 **(CONF-8706152—1) Oxidation of Ge-implanted silicon.** White, C.W.; Fathy, D.; Holland, O.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011642.

From European Materials Research Society conference; Strasbourg, France (2 Jun 1987).

The steam oxidation rate of silicon can be increased substantially by the implantation of Ge prior to oxidation. This effect is most pronounced for thin oxides. During steam oxidation, the implanted Ge is completely rejected from the growing oxide and forms an intermediate layer between silicon and $SiO_2$. Segregated Ge is epitaxial with the underlying silicon and leads to enhanced oxidation of the silicon. Enhanced oxidation is shown to arise because Ge increases the interface kinetics associated with oxide formation.

37333 **(DOE/ER/06042—7) Properties of lanthanide oxides as supports for transition metal catalysts: Progress report for the period May 1, 1986 to April 30, 1987.** Rosynek, M.P. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1987. Contract AS05-78ER06042. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011087.

Objective of this project is to provide an understanding of the manner in which variations in oxidic support materials, particularly lanthanide oxides, and metal precursors influence the reduction, surface, and catalytic properties of dispersed non-noble Group VIII transition metals. During the past year, we have performed detailed temperature-programmed reduction (TPR) studies of two series of silica-supported cobalt catalysts, in an effort to elucidate the role played by various metal precursor compounds in determining the surface state of dispersed cobalt. These investigations have resulted in an understanding of the potential complexity of the metal reduction process and of the marked effect exerted by adsorbed water and surface hydroxyls.

37334 **(DOE/ER/45077—3) Spectroscopic investigations of glass structure: Final report for the period April 1, 1984-December 31, 1986.** White, W.B. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 1 May 1987. Contract FG02-84ER45077. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012147.

This is the final report on an investigation of insulator glass structure, the hydrolysis of glasses, and the properties of transition metal ions dissolved in glasses. Infrared and Raman spectroscopy were used to specify the structural building blocks of the glass-forming network and indicate the degree of polymerization of the network. In the case of borate glasses, high temperature Raman spectroscopy identified the dissociation and recombination of boroxal rings. Recent work focused on the structural role of aluminum in silicate glasses and the use of magic angle spinning NMR to elucidate glass structure. Far infrared spectroscopy reveals the struc-

tural arrangement of alkali and alkaline earth ions. Transition metals of the first long series of the periodic table were investigated by optical absorption and luminescence spectroscopy. Titanium and ferric iron form tetrahedral units that polymerize into the glass structure. Other transition ions substitute as bare ions into cage sites in the glass framework and as quasi-molecular tetrahedral and octahedral complexes. More than one species may be present under the same preparation conditions.

37335 **(DOE/ER/45163—10) X-ray spectroscopy of solids under pressure: Technical progress report, July 1984-April 1987.** Ingalls, R.L. (Washington Univ., Seattle (USA). Dept. of Physics). 30 Apr 1987. Contract FG06-84ER45163. 11p. NTIS, PC A02. File Number DE87011829.

The pressure range was from 1 bar to 220 kbar. Synchrotron x-ray absorption spectroscopy is well suited to high pressure studies. Alkali metal halides were used in the initial tests. The zinc-blende structures ZnSe and CuBr were also studied. Other materials used were Cu, SmSe, $GeO_2$, and $ReO_3$. Current research is described. (DLC)

37336 **(DOE/JPL/956985—1) Synthesis of organometallic compounds: Final technical report.** Parker, J. (Electrink, Inc., San Diego, CA (USA)). 28 Jan 1987. Contract NAS-7-100-956985. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009559.

The object of this project is the establishment of procedures which would allow the practical production of solutions of organometallic compounds suitable for the deposition of conductive metal films at temperatures below 250°C. Purdue University's Turner Laboratory developed the basic chemistry for the synthesis of these "oxygen bridge" organometallic compounds. A solution of a metal salt is combined with a solution of an ammonium (or amine) soap of an appropriate organic acid. The resulting product precipitate is cleaned, dried and dissolved in xylene. Control of reaction pH and reagent purity was essential in producing useful quantities of the organometallic compounds in better than 75% yields and at reasonable costs. Processes were developed for silver, bismuth, platinum, nickel, and gold organometallic products. The processes for the gold and platinum products remained difficult, giving low yields and evidence of poor product stability. It is anticipated that improvement in the removal of inorganic impurities from the product would enhance its stability. Thermal analyses were applied to the products to determine their decomposition characteristics, and rough cost studies were made to aid in comparisons with conventional metallization methods.

37337 **(IS-T—1279) Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides.** Lee, W.H. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010932.

Measurements of the magnetic contribution to the electric resistivity, static magnetic susceptibility, and low temperature heat capacity of CePtSi are reported in this work. A logarithmic increase of magnetic resistivity is observed with the decrease of temperature in the high temperature region. This is one of the characteristic features of dense Kondo system. This compound has a large value of the low temperature magnetic susceptibility (chi/sub m/ (2.4K) = 24.9 x $10^{-3}$ $cm^3$/mol) and, characteristic of heavy fermion compounds, an enormous coefficient of the electronic specific heat, $\gamma \sim 800$ mJ/mol $K^2$. ac magnetic susceptibility measurements indicate that this compound neither orders magnetically nor is superconducting above 70 mK. To understand the nature and mechanism of the heavy fermion compound CePtSi, a number of isostructural pseudoternary systems are investigated by studying the variations of lattice parameters, static magnetic susceptibility and magnetic contribution to the resistivity. Lastly, the semi-heavy fermion system CeSi/sub x/ ($1.60 \leqq x \leqq 1.90$) is examined. The rapid decrease of the magnetic ordering temperatures resulting in a non-magnetic state as the f-f atomic separations increase in the region $1.80 \leqq x \leqq 1.90$, indicates that f-ligand hybridization is the dominant mechanism of f-electron delocalization in this system. 116 refs., 13 figs., 5 tabs.

37338 **(IS-T—1281) Superconductivity, magnetism, and charge density wave formation in ternary compounds with the $Sc_5Co_4Si_{10}$-type structure.** Yang, Hung-Duen. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 118p. NTIS, PC A06/MF A01; GPO Dep. File Number DE87010927.

The variation of the superconducting transition temperature T/sub c/ with hydrostatic pressure up to 23.7 kbar is reported for eleven compounds with the $Sc_5Co_4Si_{10}$-type structure. Most of these compounds display a modest linear depression of T/sub c/ with pressure (dT/sub c/dp $\sim 10^{-5}$ K/bar), however, two materials, $Lu_5Ir_4Si_{10}$ and $Lu_5Rh_4Si_{10}$, undergo a discontinuous transformation above a critical pressure of about 20 kbar to a state with a significantly higher T/sub c/. The resistivity and magnetic susceptibility show an anomaly in $Lu_5Ir_4Si_{10}$ and $Lu_5Rh_4Si_{10}$ at $T_0 = 83$ K and 155 K respectively. It is interpreted that this phase transformation may involve a charge density wave (CDW) formation that opens an energy gap over a portion of the Fermi surface. The P-T phase diagram for $Lu_5Ir_4Si_{10}$, given to demonstrate the correlation between $T_0$ and T/sub c/, provides the clear evidence that the pressure enhancement of T/sub c/ is due to progressive removal of the charge density wave in crystal. 112 refs., 35 figs., 5 tabs.

37339 **(LBL—23427) Successful molecular beam epitaxy growth and characterization of (110) GaAs/GaAs and (110) AlGaAs/GaAs.** Allen, L.P. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010985.

Commonly observed faceting of (110) GaAs films grown by molecular beam epitaxy (MBE) has been analyzed. Facets were studied with respect to MBE growth parameters, the GaAs crystallography, their chemical, electrical, and optical nature, and the kinetics of initial formation. Facets were found to align along the [001] with side planes of (100) and (010). The back planes of the facets were consistently of (111) Ga in nature. The facets were composed of stoichiometric GaAs but resulting films were of poor optical and electrical quality. By exposing an abundance of Ga ledges on the substrate surface, the faceting of the MBE (110) GaAs surface was eliminated. This systematic approach has, for the first time, allowed facet free epitaxy growth of (110) GaAs and (110) AlGaAs/GaAs superlattices. Facet free MBE films were examined by Hall effect, photoluminescence, deep level transient spectroscopy, and transmission electron microscopy. A model of (110) GaAs facet initiation, development, and elimination is presented.

37340 **(LBL—23462) The structure of GaAs/Si(211) heteroepitaxial layers.** Liliental-Weber, Z.; Weber, E.R.; Washburn, J.; Liu, T.Y.; Kroemer, H. (Lawrence Berkeley Lab., CA (USA); California Univ., Santa Barbara (USA). Dept. of Electrical and Computer Engineering). May 1985. Contract AC03-76SF00098. 10p. (CONF-870438—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011223.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Gallium arsenide films grown on (211)Si by molecular-beam epitaxy have been investigated using transmission electron microscopy. The main defects observed in the alloy were of misfit dislocations, stacking faults, and microtwin lamellas. Silicon surface preparation was found to play an important role on the density of defects formed at the Si/GaAs interface. Two different types of strained-layer superlattices, InGaAs/InGaP and InGaAs/GaAs, were applied either directly to the Si substrate, to a graded layer (GaP-InGaP), or to a GaAs buffer layer to stop the defect propagation into the GaAs films. Applying InGaAs/GaAs instead of InGaAs/InGaP was found to be more effective in blocking defect propagation. In all cases of strained-layer superlattices investigated, dislocation propagation was stopped primarily at the top interface between the superlattice package and GaAs. Graded layers and unstrained AlGaAs/GaAs superlattices did not significantly block dislocations propagating from the interface with Si. Growing of a 50 nm GaAs buffer layer at 505°C followed by 10 strained-layer superlattices of InGaAs/GaAs (5 nm each) resulted in the lowest dislocation density in the GaAs layer ($\sim 5$ x $10^7$/$cm^2$) among the structures investigated. This value is comparable to the recently reported density of

dislocations in the GaAs layers grown on (100)Si substrates. Applying three sets of the same strained layers decreased the density of dislocations an additional ~2 to 3 times.

37341 **(MLM—3428(OP)) Mechanical testing of carbon foam.** Merten, C.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Apr 1987. Contract AC04-76DP00053. 11p. (CONF-8704140—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009197.

From Advanced materials workshop; Livermore, CA, USA (21 Apr 1987).

A theoretical analysis has been performed which predicts the effect of eccentric loading on measured mechanical properties. A fixture which minimizes bending and eccentric loading has been described. Preliminary results of compression tests on low density carbon foam have also been reported. Finally, an experiment to verify the predicted effects of misalignment and eccentric loading has been conducted. The results of this experiment are consistent with values predicted by theory.

37342 **(N—87-20386) Baseline tensile tests of composite materials for LDEF (Long duration exposure facility) exposure.** Witte, W.G. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Mar 1987. 62p. (NASA-TM—89069; NAS—1.15:89069). NTIS, PC A04/MF A01.

Tensile specimens of five graphite fiber reinforced composite materials were tested at room temperature to provide baseline data for similar specimens exposed to the space environment in low-Earth orbit on the NASA Long Duration Exposure Facility. All specimens were 4-ply (+ or - 45 deg)s layups; at least five replicate specimens were tested for each parameter evaluated. Three epoxy-matrix materials and two polysulfone-matrix materials, several fiber volume fractions, and two sizes of specimen were evaluated. Stress-strain and Poisson's ratio-stress curves, ultimate stress, strain at failure, secant modulus at 0.004 strain, inplane shear stress-strain curves, and unidirectional shear modulus at .004 shear strain are presented.

37343 **(N—87-20387) Advanced composite combustor structural concepts program. Final Report.** Sattar, M.A.; Lohmann, R.P. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). Dec 1984. 118p. (NASA-CR—174733; NAS—1.26:174733; PWA—5890-24). NTIS, PC A06/MF A01.

An analytical study was conducted to assess the feasibility of and benefits derived from the use of high temperature composite materials in aircraft turbine engine combustor liners. The study included a survey and screening of the properties of three candidate composite materials including tungsten reinforced superalloys, carbon-carbon and silicon carbide (SiC) fibers reinforcing a ceramic matrix of lithium aluminosilicate (LAS). The SiC-LAS material was selected as offering the greatest near term potential primarily on the basis of high temperature capability. A limited experimental investigation was conducted to quantify some of the more critical mechanical properties of the SiC-LAS composite having a multidirection 0/45/-45/90 deg fiber orientation favored for the combustor linear application. Rigorous cyclic thermal tests demonstrated that SiC-LAS was extremely resistant to the thermal fatigue mechanisms that usually limit the life of metallic combustor liners. A thermal design study led to the definition of a composite liner concept that incorporated film cooled SiC-LAS shingles mounted on a Hastelloy X shell. With coolant fluxes consistent with the most advanced metallic liner technology, the calculated hot surface temperatures of the shingles were within the apparent near term capability of the material. Structural analyses indicated that the stresses in the composite panels were low, primarily because of the low coefficient of expansion of the material and it was concluded that the dominant failure mode of the liner would be an as yet unidentified deterioration of the composite from prolonged exposure to high temperature. An economic study, based on a medium thrust size commercial aircraft engine, indicated that the SiC-LAS combustor liner would weigh 22.8N (11.27 lb) less and cost less to manufacture than advanced metallic liner concepts intended for use in the late 1980's.

37344 **(N—87-20421) Investigation of PTFE transfer films by infrared emission spectroscopy and phase-locked ellipsometry.** Lauer, J.L.; Bunting, B.G.; Jones, W.R. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1987. 16p. (NASA-TM—89844; E—3505; NAS—1.15:89844; CONF-870510—4). NTIS, PC A02/MF A01.

From Annual meeting of the American Society of Lubrication Engineers; Anaheim, CA, USA (11 May 1987).

When a PTFE sheet was rubbed unidirectionally over a smooth surface of stainless steel an essentially monomolecular transfer film was formed. By ellipsometric and emission infrared spectroscopic techniques it was shown that the film was 10 to 15 A thick and birefringent. From the intensity differences of infrared bands obtained with a polarizer passing radiation polarized in mutually perpendicular planes, it was possible to deduce transfer film orientation with the direction of rubbing. After standing in air for several weeks the transfer films apparently increased in thickness by as much as threefold. At the same time both the index of refraction and the absorption index decreased. Examination of the surfaces by optical and electron microscopies showed that the films had become porous and flaky. These observations were consistent with previous tribological measurements. The coefficients of friction decreased with the formation of the transfer film but increased again as the film developed breaks. The applicability of the ellipsometric and polarized infrared emission techniques to the identification of monomolecular tribological transfer films of polymers such as PTFE has been demonstrated.

37345 **(N—87-20820) Computational analyses of crystal growth. Final report.** Dakhoul, Y.M. (Continuum, Inc., Huntsville, AL (USA)). Jan 1987. 63p. (NASA-CR—179027; NAS—1.26:179027; CI-FR—0102). NTIS, PC A04/MF A01.

Two important aspects of Hg/Cd/Te crystal growth processes are discussed. First, the thermal field and second, the fluid movement in the melt zone. The thermal analysis includes numerical calculation of axisymmetric heat conduction within the sample. It also includes a three-dimensional radiation model to calculate the radiative heat exchange between the furnace and the crystal as determined by the complex geometry of the furnace and the adiabatic shield. The thermal analysis also includes a crystal conductivity which is dependent on temperature and composition. To tackle the fluid flow aspect of the problem, an attempt was made to use a newly developed incompressible flow code based on the slight compressibility, and hence the finite sound speed, of all real fluids.

37346 **(N—87-21043) Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: an initial study.** Garcia, D.; Bowles, K.J.; Vannucci, R.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1987. 30p. (NASA-TM—89846; E—3472; NAS—1.15:89846). NTIS, PC A03/MF A01.

Styrene terminated polysulfone oligomers are part of an oligomeric class of compounds with end groups capable of thermal polymerization. These materials can be used as matrices for graphite reinforced composites. The initial evaluation of styrene terminated polysulfone oligomer based composites are summarized in terms of fabrication methods, and mechanical and environmental properties. In addition, a description and evaluation is provided of the NASA/Industry Fellowship Program for Technology Transfer.

37347 **(SAND—87-0178) Small-Scale Seal Performance Test Series "A" thermal/structural data through the 180th day.** Stormont, J.C. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011585.

As part of an in-situ test of the performance of concrete seals, measurements of temperature, strain, stress, and displacement are being made in seals and in adjacent rock. The seals vary in size from 15.2-cm diameter by 30.4-cm length to 91.4-cm diameter by 91.4-cm length, and are located in vertical boreholes in predominately halite host rock. This report contains data collected through

the 180th day after seal emplacement and presents discussion and conclusions based on these data. A double hump in the temperature history resulting from concrete hydration was consistently observed and is thought to be a result of the two-phase hydration of the concrete. The concrete strain and stress data indicate that creep of adjacent rock is the predominant mechanism for stress and strain changes in the seals. The trend of these data suggests that they may eventually stabilize or equilibrate. The seals exhibited little structural response to a 2-MPa axial load from fluid flow/permeability testing, indicating substantial concrete/rock interface strength. 13 refs., 23 figs., 10 tabs.

37348 **(SAND—87-0315) Shock-modified transition metal ferrites.** Venturini, E.L.; Morosin, B.; Graham, R.A.; Williamson, D.L.; Williams, F.L. (Sandia National Labs., Albuquerque, NM (USA); Colorado School of Mines, Golden (USA); New Mexico Univ., Albuquerque (USA)). Jun 1987. Contract AC04-76DP00789. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012340.

The physical properties of four spinel-structure ferrite powders (copper, cobalt, nickel and iron ferrite), subjected to high pressure shock loading and preserved for post-shock analysis, have been studied by x-ray diffraction, static magnetization and Moessbauer spectroscopy. X-ray diffraction shows residual strains typically greater than 0.1%, indicative of large shock-induced plastic deformation. Static magnetization reveals major strain-induced changes in magnetostrictive energies of magnitudes comparable to magnetocrystalline energies. At high applied magnetic fields it is found that saturation magnetization, magnetic hardness and magnetic susceptibility are strongly altered by the shock-modification process. Moessbauer measurements show apparent changes in magnetic-ion site distributions attributed to a reduction in crystallite size. There is evidence that about 15% of the magnetite is converted to hematite by the shock process. In summary, the shock-modified ferrite powders show major changes in their magnetic characteristics. Shock modification is shown to be an effective process to achieve unique states in these materials.

37349 **(SAND—87-0404C) The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices.** Biefeld, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870761—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010739.

From 3. international conference on modulated semiconductor structure; Montpelier, France (6 Jul 1987).

Surface defects have been studied in InAs/sub x/Sb/sub 1-x//InSb strained-layer superlattices as a function of the profile of compositionally graded buffer layers. Comparisons were made between constant composition, step-graded and continuously graded buffer layers. The use of either constant composition layers or step-graded buffer layers resulted in an increase in surface defects for large lattice mismatch ($x > 0.1$). Surface defects were minimized by the use of continuously graded buffer layers for $x = 0.2$.

37350 **(SAND—87-0620) Kevlar/epoxy laminates: Mechanical response of as-fabricated and shock-loaded materials.** Guess, T.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012314.

An experimental program supporting composite lethality and hardening studies is described. Purpose of the study was to generate baseline mechanical properties for as-fabricated materials and to begin characterizing the residual stiffness and strength of shock-loaded composites. Kevlar 49/epoxy composite plates, fabricated to be representative of state-of-the-art composite rocket motorcases, were chosen for evaluation. Tension, compression, three-point bend and four-point bend tests were conducted. Stress-strain curves, failure strengths, and failure modes are reported for laminates of two different thicknesses and densities. Lamina properties in conjunction with laminated plate theory were used to predict the elastic response of the different specimen geometries. Good agreement between theoretical and experimental values of elastic response was obtained. Four specimens were shock-loaded up to 3.0 kbar in gas gun spall tests. Impacted specimens were examined for damage and short beam shear specimens cut from impacted disks were tested for residual stiffness and strength. Incipient spall appears to occur at impact stresses of 1.0 kbar or less. Specimen stiffness and load carrying capacity of the Kevlar/epoxy composite were reduced by 80% and 30%, respectively, after impact at a 2.0 kbar level.

37351 **(SAND—87-0636C) Thermal expansion of low-density microcellular foams.** Drotning, W.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870988—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010431.

From 16. annual conference of the North American Thermal Analysis Society; Washington, DC, USA (27 Sep 1987).

There has been considerable recent interest in the development and application of low-density, microcellular foams. Researchers at our laboratory have successfully developed techniques for producing polymeric and carbon-based foams with densities as low as 0.02 g/cc and cell sizes in the range 1 to 20 micrometers. These materials have been considered for a wide variety of applications, such as laser fusion targets, artificial blood vessels, filters, catalytic substrates, and microporous membranes. This paper describes the results of thermal expansion measurements by pushrod dilatometry on a number of these foam materials. Low-density carbon foams can exhibit expansion coefficients as low as glassy carbon. Depending on the processing technique and the thermal history, thermal expansion behavior can be significantly modified in these materials.

37352 **Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon.** McMahon, T.J.; Tsu, R. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **51**: No. 6, 412-414(10 Aug 1987). Contract AC02-83CH10093.

We find the equilibrium temperature for intrinsic glow discharge amorphous silicon to be 195—200 °C. Defects left behind after fast cooling result in a temperature-dependent dc photoconductivity which shows small differences in the tail state recombination kinetics when compared to defects left behind in the same number after light soaking. Finally anneal kinetics of fast cool defects follow neither singly activated, mono-, nor bimolecular kinetics with a temperature dependence indicating activation energies from 1.0 to 1.4 eV. Unlike the distribution of defects left behind in similar number as a result of light soaking at room temperature, the distribution of defects resulting from fast cooling from higher temperature is shifted to higher energies and requires much longer anneal times.

37353 **Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100).** Chang, S.h.; Thiel, P.A. (Department of Chemistry and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* **59**: No. 3, 296-299(20 Jul 1987). Contract W-7405-ENG-82.

A metastable c(2 x 2) structure is formed by atomic oxygen on Pd(100) under conditions of slow diffusion combined with rapid adsorption. We propose that formation of the c(2 x 2) under these conditions must be controlled by characteristics of the dissociative adsorption event itself.

37354 **Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$.** Samara, G.A.; Terauchi, H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **59**: No. 3, 347-350(20 Jul 1987). Contract AC04-76DP00789.

The proton-glass phase in Rb/sub 0.5/(NH)/sub 0.5/$H_2PO_4$ can be completely suppressed by 5 kbar, and the details of this suppression are indicative of the nonequilibrium nature of the glass transition. There is a large hydrogen isotope effect not only on the dynamic glass-transition temperature but also on its pressure derivative. The results emphasize the importance of the proton's intrabond motion in the freezing dynamics.

**37355 X-ray diffraction study of the metastable charge-density-wave state of K/sub 0.3/$MoO_3$.** Mihaly, L.; Lee, K.; Stephens, P.W. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Physical Review [Section] B: Condensed Matter;* **36**: No. 3, 1793-1795(15 Jul 1987).

The charge-density-wave superlattice peak (0,0.25,5.5) was investigated in the blue bronze K/sub 0.3/$MoO_3$ at 10 K. The width of the peak is resolution limited for samples cooled in zero field. Application of an electric field of 24 V/cm causes a broadening of the diffraction peak width in directions both parallel and perpendicular to the chain direction b/sup */. The broadening develops on a time scale of —500 sec, and it remains unchanged after the field is removed.

**37356 Metal site disorder in zinc tin phosphide.** Ryan, M.A.; Peterson, M.W.; Williamson, D.L.; Frey, J.S.; Maciel, G.E.; Parkinson, B.A. (Department of Chemistry, Mount Holyoke College, South Hadley, Massachusetts 01075). *Journal of Materials Research;* **2**: No. 4, 528-537(Jul 1987).

The optoelectronic properties of the II—IV—$V_2$ semiconductor $ZnSnP_2$ are studied as a function of the cooling rate of the crystal growth melt. The structure of the material, as studied by x-ray diffraction, is seen to change from chalcopyrite to sphalerite as the cooling rate is increased. Photoelectrochemical measurements show that the bandgap of the material decreases from 1.64 eV for the chalcopyrite to 1.25 eV as the structure approaches sphalerite. The $^{119}Sn$ Moessbauer spectroscopy shows both an isomer shift and a broadening of the $^{119}Sn$ resonance as a result of new tin environments produced by disordering of zinc and tin sites at the faster cooling rates. The $^{31}P$ solid-state nuclear magnetic resonance spectroscopy clearly shows new resonances associated with the additional phosphorus environments produced by metal site disordering. A model based on zinc and tin site exchange with the introduction of compensating donor and acceptor states is proposed and discussed.

**37357 Mechanism of Schottky barrier formation: The role of amphoteric native defects.** Walukiewicz, W. (Center for Advanced Materials, Lawrence Berkely Laboratory, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **5**: No. 4, 1062-1067(Jul 1987).

A correlation between the Fermi level pinning deduced from Schottky barrier heights and from electrical properties of irradiated III—V semiconductors is found. The correlation indicates that similar defects are responsible for the Fermi level stabilization in both cases. It is proposed that amphoteric native defects, i.e., the defects which change their electrical characteristics depending on the Fermi level position, play a dominant role in the processes leading to a Schottky barrier formation. A detailed analysis of metal—GaAs contacts shows that in this case the amphoteric defects responsible for the barrier heights are V/sub Ga/ (acceptor) and a donor complex As/sub Ga/+V/sub As/. It is shown that for thick metal coverages two barriers are formed. A surface barrier determined by the charge associated with a native defect and the bulk barrier controlled by the bulk doping. The sum of the two barrier heights satisfies the Schottky condition for the interface, but it is the bulk barrier that determines the macroscopic electrical properties of the contact. The model explains the evolution of the Fermi level position at the interface observed for metal coverages varying in a broad range of thicknesses. The relationship of the present proposal to previous models of Schottky barriers is discussed.

**37358 Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries.** Han, S.M.; Armstrong, D.W. (Texas Tech Univ., Lubbock). *Analytical Chemistry;* **59**: No. 11, 1583-1584(1 Jun 1987). Contract AS05-84ER13159.

A variety of fused-silica LC microcolumns have been packed in our laboratory. Some columns became very brittle and essentially impossible to handle without breaking. In some cases, one portion of a packed column would remain flexible while another section would be brittle. In this report the origin and cause of brittleness in polyimide- and aluminum-clad fused-silica packed capillaries is examined.

**37359 Switching phenomena in a new 90-K superconductor.** Hor, P.H.; Meng, R.L.; Chu, C.W.; Wu, M.K.; Zirngiebl, E.; Thompson, J.D.; Huang, C.Y. (Houston Univ., TX, USA. Dept. of Physics; Alabama Univ., Huntsville, US. Dept. of Physics; Los Alamos National Lab., NM, USA; Lockheed Palo Alto Research Labs., CA, USA). *Nature (London);* **326**: No. 6114, 669-670(16 Apr 1987).

Recently, it has been shown that Ysub(1.2)Basub(0.8)CuOsub(4-delta) is a superconductor with a superconducting onset temperature at approx. 92 K, as determined by the resistivity and a.c. susceptibility measurements. Because the magnetic properties are important in describing the nature of superconductivity, the authors have measured the d.c. magnetic moment of this material. It is shown that this material cooled in zero field or in a high field (Hsub(cool>90 G) is diamagnetic below Tsub(cm)approx. = 90 K, consistent with the previous measurements. However, when the sample is cooled in a small field (<=85 G), the magnetization, M, first becomes negative (diamagnetic) below Tsub(cm), but further cooling results in a jump of M to a positive value at low temperature. This switching has also been observed by the application of an additional small field when the sample was cooled in a small field.

**37360 YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type.** Dwight, A.E. (Northern Illinois Univ., DeKalb, IL 60115). *Materials Research Bulletin;* **22**: No. 2, 201-204(Feb 1987).

Unit cell constants are reported for eight ternary compounds with the ZrPt/sub 2/A iota-type crystal structure. Compositions are (Gd, Tb, Y, Dy or Ho)Pt/sub 2/In, and (Tb Y or Tm)Pt/sub 2/Sn. The crystal structure of YPt/sub 2/In is hP8, P6/sub 3//mmc, with Y in 2c, Pt in 4f, and In in 2a sites. The interatomic bonds which show the highest contraction are between a Pt atom and 3 In atoms. A comparison is made with the competing MnCu/sub 2/A iota-type structure in YPd/sub 2/In.

**37361 The effect of radiation on twinning in quartz.** Shiau, S.M.; Newnham, R.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). *Materials Research Bulletin;* **22**: No. 2, 227-234(Feb 1987).

The Dauphine twinning behavior of quartz subjected to irradiation was studied at room temperature and elevated temperatures. The presence of defects produced by irradiation was utilized to pin the domain wall motion. Both neutrons and gamma-rays were employed for this investigation. The stress required to nucleate an appreciable volume of twins is about twice as high for irradiated crystals than those unirradiated. However, the coercive stress required for causing a complete orientation switch was not much different between irradiated and unirradiated crystals.

**37362 Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material.** Rokhlin, S.I.; Bolland, T.K.; Adler, L. (Ohio State Univ., Columbus). pp 1103-1110 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract FG02-84ER45057.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The objective of this paper is to analyze reflection and refraction phenomena between coupling media containing an ultrasonic transducer and the composite material, and between layers with different fiber orientations in the composite material, both in immersion and contact variants of ultrasonic tests. For their calculations, they will use a general algorithm which was recently developed for analysis of wave interaction with the interface between two generally anisotropic media. This algorithm was slightly modified to take into consideration slip interfaces between solids, and if needed, liquid media.

37363 **Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter.** Roberts, R.A. (Argonne National Lab., IL). pp 1147-1156 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The use of ultrasonic backscatter to characterize anomalous states in fiber-reinforced composites has received considerable attention in recent years. The ultrasonic backscatter from composites with oriented fiber reinforcement, unlike that from monolithic materials, displays a strong angular dependence. Hence, three independent variables are available over which to analyze the backscatter. These are the azimuthal angle phi (the rotation orientation of the composite plate about the perpendicular), the elevation angle theta (the angle between the ultrasonic beam and the perpendicular to the insonified composite plate), and time. Bar-Cohen and Crane considered various ways of exploiting the angular dependence of backscatter to examine anomalies in composite laminates such as fiber misalignment, cracks, and porosity. Several other efforts employing similar approaches have followed. This paper addresses specific questions concerning the angular dependence of backscatter and the use of this angular dependence to assess porosity levels. Additionally, problems inherent in the analysis of the temporal behavior of backscatter are discussed, and an approach to the spectral analysis of backscatter for porosity assessment is demonstrated.

37364 **Ultrasonic signal analysis of composite structures using the entire waveform.** Brosey, W.D. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN). pp 1247-1255 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Publishing (1987). (CONF-8608142—). Contract AC05-84OR21400.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

An increased use of composites in enclosed geometries has led to the desire to transfer and further develop the most promising NDE techniques used on nonenclosed geometries to enclosed geometries. As part of the further development of ultrasonic inspection techniques, a high-speed data-acquisition system has been assembled which digitizes an entire RF signal waveform at each point on a Kevlar-epoxy composite structure. The complete data set of ultrasonic A-scans is then available for analysis of particular features which might ordinarily have been overlooked when only the maximum amplitude is recorded from data in a preset gate. The system provides a three-dimensional view of the data in which either the XY, YZ, or XZ planes can be displayed using pseudo color or gray scale to indicate the maximum signal amplitude in a gate set under program control. Depth information can be displayed on the XY data plane, and various image display techniques can be implemented to enhance certain material or defect conditions.

37365 **Ultrasonic attenuation measurement by backscattering analysis.** Nagy, P.B.; Rypien, D.V.; Adler, L. (Ohio State Univ., Columbus). pp 1411-1418 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The feasibility of nondestructive porosity assessment by ultrasonic attenuation measurement was investigated. The porosity induced attenuation was calculated by comparing the backscattered power spectra from layers in different depths. Excessive spatial averaging was used to eliminate the random nature of the backscattered signals. Both the average pore radius and volume fraction were quantitatively determined from the frequency dependent attenuation coefficient. By comparing the results of the collimated beam through-transmission and backscattering techniques, the predicted pore radii were found to be in reasonably good agreement, but the volume fraction was underestimated in the latter case by as much as 50%. To explain this deficiency, they suggested that the backscattered signal is less attenuated by scattering even at the very beginning of the signal. A new theoretical analysis is needed to account for the incoherent diffuse nature of the backscattered signal in the calculation of the scattering induced attenuation. A simple model was introduced to demonstrate the high degree of overestimation made by using the total scattering cross-section to calculate the attenuation. The backscattering technique measures the average intensity in a certain depth rather than the (phase-sensitive) field average, therefore the resultant attenuation is smaller than that of the coherent through-transmitted signal.

37366 **Josephson and quasiparticle tunneling studies of $LiTi_2O_4$.** Ng, K.W. Ames, IA; Iowa State Univ. (1986). 117p. University Microfilms Order No. 87-03,739.Contract W-7405-ENG-82.

Thesis (Ph. D).

Josephson and quasiparticle tunneling measurements were performed on superconducting $LiTi_2O_4$. High quality, dense samples were made by arc melting $LiTi_2O_4$ pellets produced by sintering constituent powders of $Li_2CO_3$, $Ti_2O_3$, and $TiO_2$. The conductive spinel phase was recovered by annealing the ingot for about two months. The sample was characterized by x-ray diffraction and a-c susceptibility, and it was shown to be in the correct crystal structure with only a slight amount of impurity and have a proper superconducting critical temperature of 11.3 K. Josephson point contact tunneling between $LiTi_2O_4$ and Nb reveals, under K-band microwave radiation of frequency nu = 25.2 GHz, Shapiro steps of spacing approximately h nu/2e. The squeezable junction method of Moreland and Hansma was applied to study the superconducting energy gap of an arc-melted bulk $LiTi_2O_4$ sample and also of co-sputtered MoRe films. The MoRe film was estimated to have an energy gap of $LiTi_2O_4$ is determined to be 1.95 +/- 0.03 mV corresponding to 2Δ/k/sub B/T/sub c/ = 4.00 +/- 0.06, making this material a conventional, electron-phonon strong-coupled superconductor.

37367 **Assessment of methods for characterization of polyolefin dielectrics.** Gaines, G.B.; Epstein, M.M.; Eaton, R. (Battelle-Columbus Div.). pp 144 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—).

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

Since the middle 1970's, researchers concerned with understanding aging and failure processes in electrical insulation have devoted increased attention to measuring chemical and morphological changes brought about by exposure to single and multiple stresses. Increased understanding has come about in part by steady improvements in the sophistication, sensitivity, and precision of the modern scientific instruments that have become available in recent years. The first large-scale coordinated attempt to utilize advanced polymer characterization methods was an integral part of a recently completed Department of Energy-sponsored project concerned with aging and accelerated testing of solid cables insulated with thermoplastic polyethylene and cross-linked polyethylene. The purpose of these studies was to ascertain the nature of the deterioration during accelerated testing and to determine if the mechanisms of aging during accelerated testing are consistent with changes likely to occur under conditions of normal operating stress.

37368 **Materials performance analysis of perfluorocarbon liquid/plastic film capacitors.** Yen, S.P.S.; Somoano, R.; Mauldin, G.H. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). pp 73-75 of Conference record of the 1986 IEEE international symposium on electrical insulation. Piscataway, NJ; IEEE Service Center (1986). (CONF-860693—).

From International symposium on electrical insulation; Washington, DC, USA (8 Jun 1986).

The perfluorocarbon liquid/plastic film capacitor technology represents an exciting approach to achieving significant improvements in the performance required for advanced pulse power applications. In particular, the unique properties of perfluorocarbon liquids offer a convenient in situ mechanism for improving thermal management. The authors report on the results of our studies of the

materials performance in multilayer polycarbonate (PC)/perfluorocarbon capacitors which have undergone long term pulsing at 1100 Hz and at fields of —3-5 kV/mil. It is believed that thermally-induced degradation is the principal failure mode in these capacitors since a typical failure usually involves punch-through in the bulk of the capacitor far removed from the heat sink region (and not at the foil edge).

37369 **Sol-gel AR films for solar applications.** Ashley, C.S.; Reed, S.T. (Sandia National Labs., Albuquerque, NM). pp 671-678 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Sol-gel derived antireflective films have been prepared for a variety of solar applications. The optical properties of the films are optimized by microstructure tailoring in solution by aging and/or in the film by heating and etching. The resulting film provides a quarter-wave, single layer interference surface with a reflectance minimum of $<1\%$ at 600 nm. The authors have applied sol-gel derived AR films to glass and plastics for solar thermal and photovoltaic applications, e.g., parabolic trough collector envelopes, plastic Fresnel lenses, and glazing materials for flat plate collectors.

# 40 CHEMISTRY

*REFER ALSO TO CITATION(S) 37197*

## 4001 Analytical And Separations Chemistry

*REFER ALSO TO CITATION(S) 37310, 37313, 37317, 37318, 37320, 37322, 37323, 37358, 37367, 37425, 37426, 37427, 37437, 37519, 37563, 37635, 37636, 37656, 37873, 38035, 38045*

37370 **(CONF-870498—8) Present and future prospects of accelerator mass spectrometry.** Kutschera, W. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011413.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

Accelerator Mass Spectrometry (AMS) has become a powerful technique for measuring extremely low abundances ($10^{-10}$ to $10^{-15}$ relative to stable isotopes) of long-lived radioisotopes with half-lives in the range from $10^3$ to $10^8$ years. With a few exceptions, tandem accelerators turned out to be the most useful instruments for AMS measurements. Both natural (mostly cosmogenic) and man-made (anthropogenic) radioisotopes are studied with this technique. In some cases very low concentrations of stable isotope are also measured. Applications of AMS cover a large variety of fields including anthropology, archaeology, oceanography, hydrology, climatology, volcanology, minerals exploration, cosmochemistry, meteoritics, glaciology, sedimentary processes, geochronology, environmental physics, astrophysics, nuclear and particle physics. Present and future prospects of AMS are discussed as an interplay between the continuous development of new techniques and the investigation of problems in the above mentioned fields. Typical factors to be considered are energy range and type of accelerator, and the possibilities of dedicated versus partial use of new or existing accelerators.

37371 **(CONF-870763—1) Preparation of radioactive "mixed" waste samples for measurement of RCRA [Resource Conservation and Recovery Act] organic compounds.** Tomkins, B.A.; Caton, J.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010906.

From 3. annual solid waste testing and quality assurance symposium; Washington, DC, USA (14 Jul 1987).

A radioactive "mixed" waste typically contains alpha-, beta-, or gamma-emitting radionuclides and varying quantities of semivolatile or volatile organic species, some or all of which may be named specifically by the Resource Conservation and Recovery Act (RCRA). Because there are no acceptable means available currently for disposing of these mixed wastes, they are presently stored above-ground in sealed drums. For this reason, analytical procedures which can determine RCRA organics in radioactive waste are necessary for deciding the proper approach for disposal. An important goal of this work is the development of methods for preparing mixed waste samples in a manner which allows the RCRA organics to be measured in conventional organic analysis laboratories without special precautions. Analytical procedures developed for handling mixed waste samples must satisfy not only the usual constraints present in any trace-level organic chemical determination, but also those needed to insure the protection of the operator from radioactive contamination. Consequently, procedures should be designed to use the least amount of radioactive sample commensurate with achieving acceptable sensitivity with the RCRA analytical methods. Furthermore, the unusual laboratory glassware which would normally be used should be replaced with disposable materials wherever possible, in order to reduce the "clean-up" time required, and thereby reduce the operator's exposure to radioactivity. Actual sample handling should be reduced to the absolute minimum. Finally, the final isolate must exhibit a sufficiently low level of alpha, beta, or gamma activity to permit detailed characterization in a conventional organic analysis laboratory. 4 refs., 5 tabs.

37372 **(CONF-870763—2) The determination of chlorophenoxy acid herbicides by liquid chromatography using carbon-14 tracers.** Merriweather, R.; Caldwell, W.M.; Maskarinec, M.P.; Caton, J.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011932.

From 3. annual solid waste testing and quality assurance symposium; Washington, DC, USA (14 Jul 1987).

The extractive recovery of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2-(2,4,5-trichloro)phenoxypropionic acid (Silvex) from environmental samples was evaluated using carbon-14 tracers of the acid form of both herbicides. Recoveries using methylene chloride or 1:1 methylene chloride:acetone for solids exceeded 75% when the material being extracted was maintained at an acid pH (pH $\leq$2). Following extraction, the extract is taken to dryness and then dissolved in the solution being used for HPLC elution. Two slightly different isocratic elutions with reversed phase columns were studied. In the first system studied a heavily loaded (18% carbon by weight), completely endcapped C18 reversed phase column was eluted with an aqueous solution of 30% (v/v) acetonitrile that contained 0.001 M concentration of a pH 4.6 acetate buffer. The effluent from this column was monitored at 280 nm. The minimum amount detected, when monitoring at 280 nm, is 100 ng of either Silvex or 2,4-D in the injected sample. A second isocratic elution system avoided the use of a buffered eluent by utilizing a high performance reversed phase column and an aqueous methanol (20% v/v) eluent. This second column has been monitored at multiple wavelengths with a diode array detector. The sensitivity of detection can be greatly increased at wavelengths below 240 nm; however, any real sample must be very "clean" in order to avoid interferences when monitoring below 230 nm. Thus monitoring at 280 nm is probably optimal for real environmental samples. At this wavelength the detectable concentration of either herbicide in the solution being injected is 5 ppM for a 20 $\mu$l injection.

37373 **(DOE/ER/04073—20) Chelating extractants of improved selectivity: Final report.** Freiser, H. (Arizona Univ., Tucson (USA). Dept. of Chemistry). May 1987. Contract AC02-76ER04073. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011190.

The research under this grant was directed towards the development of selective lanthanide (and, by analogy, of actinide) extractants. A series of twenty chelating extractants, including members of the 8-quinolinol, aryl hydroxamic acid, acylpyrazolone, pyridylazophenols and acidic phosphorus families, coupled with nine adductants, i.e., neutral auxiliary ligands with either O or N bonding atoms, and two quaternary ammonium ion pairing agents were synthesized or obtained, and their equilibrium extraction behavior with $La^{3+}$, $Pr^{3+}$, $Eu^{3+}$, $Ho^{3+}$, and $Yb^{3+}$ as representative $Ln^{3+}$ was investigated. This work, involving over 200 equilibrium systems, significantly enlarged the data base of $Ln^{3+}$ extraction, yielded a

number of useful correlations of structure and selectivity, and provided guidelines for further reagent design.

37374 **(DOE/ER/10604—7) Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987.** Bartsch, R.A. (Texas Tech Univ., Lubbock (USA)). Jun 1987. Contract AS05-80ER10604. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011979.

A variety of lipophilic crown ethers with pendant ionizable groups has been prepared. Several lipophilic acyclic polyethers bearing either one or two ionizable groups have also been synthesized. Complexation of alkali metal and alkaline earth cations by such novel ligands has been probed using NMR and solvent extraction. Effects of ring size, side arm length, ionizable group identity and other structural variations, as well as the effect of the solvent, the competitive alkali metal cation solvent extraction has been assessed. Investigations of heavy metal and transition metal cation complexation by ionizable crown ethers have been conducted. The influence of structural variations within acyclic polyether carboxylic acids and dicarboxylic acids on the alkali metal and alkaline earth cation solvent extraction has also been probed. New ligands have been developed which exhibit high selectivities for $Cs^{+}$ and $Ra^{2+}$ in solvent extraction processes. The ability of ionizable crown ethers to function as selective metal cation carriers in liquid membrane transport processes has been examined in both bulk liquid membrane and polymer-supported liquid membrane transport systems.

37375 **(IFP—33-261) Selective absorption of hydrogen sulfide in carbon dioxide by methyldiethanolamine. Study of a new type of vertical ascending cocurrent flow contactor.** Bensarsa, F. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison; Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Apr 1985. 386p. (In French). NTIS (US Sales Only), PC A17/MF A01. File Number DE87752317.

Hydrogen sulfide removal of gas containing a high ratio of carbon dioxide is important for example in coal gasification, natural gas, biomass gas or in CO/sub 2/ production for enhanced oil recovery. Amines present a selectivity for H/sub 2/S in respect to CO/sub 2/ because the chemical reaction rate is higher. In this work a new type of contactor is studied for a better use of differences of chemical reaction kinetics. Experiments are realized on a laboratory apparatus and a model is developed. Hydrodynamics data (pressure drop, fluid flow, liquid retention) and mass transfer are determined.

37376 **(N—87-20400) Application of CARS to scramjet combustion. Final report.** Antcliff, R.R. (Systems Research Labs., Inc., Dayton, OH (USA)). Apr 1987. 32p. (NASA-CR—178245; NAS—1.26:178245; REPT—6657). NTIS, PC A03/MF A01.

A coherent anti-Stokes Raman spectroscopic (CARS) instrument has been developed for measuring simultaneously temperature and $N_2$ - $O_2$ species concentration in hostile flame environments. A folded BOXCARS arrangement was employed to obtain high spatial resolution. Polarization discrimination against the nonresonant background decreased the lower limits of $O_2$ detectivity. The instrument has been primarily employed for validation of computational fluid-dynamics computer-model codes. Comparisons have been made to both the CHARNAL and TEACH codes on a hydrogen diffusion flame with good results.

37377 **(ORNL/TM—10309) Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985.** Maskarinec, M.P.; Manning, D.L.; Harvey, R.W. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011955.

In this report, the collection and determination of phenol; o-, m-, and p-cresols; 2,4,5- and 2,4,6-trichlorophenols; 2,3,4,5- and 2,3,5,6-tetrachlorophenols; and pentachlorophenol are described. The phenols are collected from water samples by adsorption on XAD-4 cartridges. After elution with diethyl ether and returning to an aqueous media, the phenols are determined by high performance liquid chromatography with electrochemical detection (HPLC/EC). The separation was obtained utilizing a cyclobond 1$\beta$ (5$\mu$) HPLC column.

37378 **(ORNL/TM—10402) An intelligent thick-film gas sensor: development and preliminary tests.** Lauf, R.J.; Hoffheins, B.S.; Walls, C.A. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011949.

Thick-film techniques were used to create a gas sensor that has a semiconducting oxide surface whose catalytic activity varies from point to point. An integral heater causes the oxide film to react with combustible gases; the electrical resistance of the oxide film is mapped through an array of electrodes to yield a 'signature' that depends on how a particular gas reacts to each of the different areas on the sensor. The catalytic activity can be varied by establishing a thermal gradient across the sensor, by distributing different catalysts in different areas, or by a combination of both effects. For simple cases, the signature can be related to the functional groups present in the gas. As an example, using a uniform distribution of platinum and a thermal gradient, alcohols, ketones, and alkanes have distinctly different signatures.

37379 **(RFP—4119) Permeation tubes for dynamic mass spectrometry calibration.** McFeeters, T.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). May 1987. Contract AC04-76DP03533. 25p. (CONF-8705128—1). NTIS, PC A02. File Number DE87011056.

From 7. annual symposium of the American Vacuum Society; Oak Ridge, TN, USA (12 May 1987).

At Rocky Flats the calibration problems have been reduced and the capabilities of the method expanded to include liquids and condensible gases by the use of commercially available standard leaks, such as those used for leak detection, and by a Rocky Flats innovation, the use of vacuum-service permeation tubes for liquids and gases not practical for use in fixed orifice leaks. These tubes are made in the laboratory from Teflon tubing and stainless steel tube fittings. The tube is filled with the desired gas or liquid and sealed. Permeation of the gas of vapor through the walls will then occur at a contant rate when equilibrated. This rate is temperature dependent. The tubes are then calibrated gravimetrically at Rocky Flats by Standards Laboratory.

37380 **(SAND—87-0146C) Comparison study of search algorithms and data base libraries for compound identification from mass spectral data.** Burns, F.B.; Rodacy, P.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-8705114—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010477.

From 35. conference on mass spectrometry and applied topics; Denver, CO, USA (24 May 1987).

Comparison of the data acquired by the Finnigan MAT for many of the unmatched compounds with library data for those same compounds shows that there is often markedly different, or even incorrect, data in different libraries. No functional group discrimination was detected in the library search results. Spectra contained in small libraries are not always present in large libraries. Because m/z-abundance intensities are instrument dependent, spectral redundancy within a library can be beneficial. Identification failures can be related to differences in library and experimental m/z-abundance data as well as the search algorithm used.

37381 **(UCRL—96796) An attempt to use high resolution FTIR spectra to determine the population of the various nitrate esters in cellulose nitrate.** Leider, H.R.; Hawley-Fedder, R.; Sanborn, R.H. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 15p. (CONF-8706106—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011879.

From JOWOG-12; Aldermaston, UK (29 Jun 1987).

The FTIR spectra of cellulose nitrates with differing ester contents show that in the region of the nitrate ester absorption ($\sim$1650 $cm^{-1}$) the changes in the shape of the absorption band are correlated with the changes in the concentration of C-6, C-2 and C-3 esters, as measured by high resolution $^{13}C$ FTNMR. Attempts to

fit the FTIR spectra to a sum of Gaussian lines show promise of defining the ester populations using FTIR alone, but considerable normalization is needed to accomplish this goal.

**37382 External heavy-atom effect in room-temperature phosphorescence.** Suter, G.W.; Kallir, A.J.; Wild, U.P.; Vo-Dinh, T. (Swiss Federal Institute of Technology, Zurich). *Analytical Chemistry;* **59**: No. 13, 1644-1646(1 Jul 1987). Contract AC05-84OR21400.

The effect of external heavy-atom perturbers on the room-temperature phosphorescence (RTP) spectrum and dibenzo-[f,h]quinoxaline (DBQ) adsorbed on Whatman 4 filter paper is reported. The totally symmetric vibrational bands are predominantly enhanced, leading to a spectral change in vibrational structure. Inhomogeneity effects of molecule-perturber interactions are investigated by time-resolved phosphorimetry and lifetime measurements.

**37383 Collision-activated dissociation of negative ions in an ion trap mass spectrometer.** McLuckey, S.A.; Glish, G.L.; Kelley, P.E. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **59**: No. 13, 1670-1674(1 Jul 1987). Contract AC05-84OR21400.

Polyatomic anions derived from several dinitrotoluene isomers, 2,4,6-trinitrotoluene, and 1,3,5-trinitro-1,3,5-triazacyclohexane have been formed by use of negative ion chemical ionization and trapped in an ion trap mass spectrometer. Mass spectrometry/mass spectrometry daughter ion spectra were obtained for most of these ions. In most cases, the parent anions were converted very efficiently to daughter ions (>10%), but for the $(M - H)^-$ ions the efficiencies were relatively low. Conversion efficiencies were observed to differ by as much as 2 orders of magnitude between anions. The major cause for these differences is attributable to differences in the propensity for collisional electron detachment vs. that for collision-activated dissociation.

**37384 Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry.** Appelhans, A.D.; Delmore, J.E.; Dahl, D.A. (EG & G Idaho, Idaho Falls). *Analytical Chemistry;* **59**: No. 13, 1685-1691(1 Jul 1987).

Beams of focused (~0.5 mm diameter at 2.5 m), rasterable, 3-17 keV neutral $SF_6$ molecules produced via autoneutralization from the corresponding anion have been demonstrated to be effective for producing secondary ions from electrically insulating specimens (e.g., Mylar, Teflon) without sample charging problems. Secondary ion currents measured with the quadrupole were $\sim 10^{-14}$ A ($10^5$ counts/s equivalent) for major peaks when using a picoampere (neutral equivalent) level primary beam which was more than adequate to characterize the specimens. No contaminating effects from S or F were seen in the spectra. The results demonstrate the feasibility of using the autoneutralizing $SF_6$ fast neutral source for a variety of static secondary ion mass spectrometry applications that require electrically neutral primary particles focused into a near-parallel small diameter beam (over distances of 18 cm to several meters). Applications could include the analysis of polymers, ceramics, and biospecimens or the generation of ions inside the magnetically confined cell of an Fourier transform ion cyclotron resonance mass spectrometer.

**37385 Pulsed-laser photothermal refraction detection in capillary liquid chromatography.** Kettler, C.N.; Sepaniak, M.J. (Univ. of Tennessee, Knoxville). *Analytical Chemistry;* **59**: No. 13, 1733-1736(1 Jul 1987).

The authors present the use of pulsed-laser photothermal refraction detection in capillary liquid chromatography (LC). Separations are performed with slurry-packed capillary columns. The technique is illustrated for the separation of nitrated pyrene isomers in a synthetic coal fly ash extract continuous wave (CW) laser, photothermal refraction detection has provided for the sensitive measurement of dabsyl-amino acids (dabsyl = (dimethylamino)azobenzenesulfonyl), following separation with a microbore LC column. The work presented herein differs in that they employ for detection an excimer pumped-dye laser tuned to the near-UV absorbance maximum of the underivatized analyte of interest and (2) employ for the separation true capillary LC using slurry-packed capillary columns. Eliminating the need to derivatize the sample in order to match the wavelength of the laser, there is no need to be concerned with whether derivatization was complete and also whether the analytes of interest have been resolved from unreacted and hydrolyzed derivatizing reagent, which may be present in the sample. The capillary columns provide excellent efficiency in this application and afford the possibility of injecting extremely small sample volumes.

**37386 Surface-enhanced Raman analysis of Benzo[A]Pyrene-DNA adducts on silver-coated cellulose substrates.** Vo-Dinh, T.; Uziel, M.; Morrison, A.L. (Advanced Monitoring Developement Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Applied Spectroscopy;* **41**: No. 4, 605-609(May 1987). Contract AC05-84OR21400.

Benzo[a]pyrene-7,8 -diol-9,10 epoxide (BPDE-)-DNA adducts have been analyzed by surface-enhanced Raman scattering (SERS) spectrometry. BPDE is the ultimate carcinogenic metabolite of benzo[a]pyrene. The SERS measurements were performed with the use of a silver-coated cellulose material as the SERS-active substrate. The acid hydrolyzed products of BPDE-DNA adducts, DNA, and the BP-tetrols were also analyzed by SERS. The results indicate that SERS has great promise as a tool for detecting BPDE-DNA adducts in biological samples.

## 4002 Inorganic, Organic And Physical Chemistry

*REFER ALSO TO CITATION(S) 36378, 36409, 36460, 36594, 36595, 36948, 37310, 37311, 37317, 37318, 37321, 37323, 37443, 37585, 37878, 38096*

**37387 (CONF-870541—2) Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory.** Wagner, A.F.; Wardlaw, D.M. (Argonne National Lab., IL (USA); Queen's Univ., Kingston, Ontario (Canada). Dept. of Chemistry). 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011424.

From Combustion fundamentals and applications: spring technical meeting of the Central States Section of the Combustion Institute; Argonne, IL, USA (11 May 1987).

A microcanonical variational RRKM rate constant calculation, based on the flexible transition state theory of Wardlaw and Marcus and an adjustable empirical potential energy surface, is compared to measurements of the methyl radical self-recombination rate constant in Ar buffer gas. The calculations contain two adjustable parameters: a potential parameter $\alpha$, which influences the tightness of the transition state and $<\Delta E>/$sub tot/, the total average energy change in metastable $C_2H_6$ per collision with the buffer gas. When the parameters are optimized, the resulting calculated rate constants have a 10.7% rms error with the measurements in Ar buffer gas. The rate calculations have been extended to 2000K and then fit over the full temperature and pressure range to a relatively simple functional form suitable for modeling studies.

**37388 (CONF-870759—1) Effect of temperature on nondissociative electron attachment to molecules.** Christophorou, L.G.; Datskos, P.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010889.

From 5. international swarm seminar; Birmingham, UK (29 Jul 1987).

The strong negative effect of temperature, T, on the nondissociative electron attachment to molecules is discussed with reference to recent studies on perfluorocarbons.

**37389 (CONF-870802—8) 4,5-methylenedithio-4',5'-propylenedithiotetrathiafulvalene (MPT) and 4,5-ethylenedithio-4',5'-propylenedithiotetrathiafulvalene (EPT).** Kini, A.M.; Tytko, S.F.; Hunt, J.E.; Williams, J.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011396.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The title electron donors, unsymmetrical analogs of Bis(ethylenedithio)tetrathiafulvalene, are synthesized. The utility of $^{252}Cf$ Plasma Desorption Mass Spectrometry in the characterization and purity determinations is also reported.

37390 **(CONF-870816—22) Dynamic behavior of reacting gas jets submerged in liquids.** Cho, D.H.; Armstrong, D.R.; Bova, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87011397.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

A photographic study of a hydrogen chloride gas jet reacting in an aqueous solution of ammonia was conducted. The high-speed motion pictures taken revealed that the behavior of the reacting gas jet was highly dynamic and complex. The gaseous jet penetration ("plume") was not stationary, but underwent a change in shape and size with time, which appeared to be periodic or cyclic. Such dynamic plume behavior is attributed to the vaporization of ammonia due to reaction heat release. In fact, the overall plume behavior resembled that of a subsonic vapor jet condensing in liquid. The plume length measurements for large concentrations of ammonia seem to confirm the prediction that when the extent of vaporization is large, the plume length is mainly determined by the distance required for condensation of the ammonia vapor.

37391 **(DOE/CH/10235—2) The spectroscopy and structure of novel high energy-high density compounds: Final progress report, May 1, 1985-July 31, 1986.** Butcher, R.J. (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 1986. Contract FG02-85CH10235. 14p. NTIS, PC A02. File Number DE87011202.

Structures of the following Co complexes were determined: $[Co(NH_3)_5(benzimidazole)](ClO_4)_3$; $[Co(NH_3)_4(2,3\text{-dimethylimidazole})_2](ClO_4)_3$; $[Co(en)_2(aniline)(Cl)]Cl_2$; $[Co(en)_2(pyridine)(Cl)]Cl_2$; $[Co(en)_2Cl_2]Cl.2DMSO$; $K[Co(en)(CO_3)_2].H_2O$; and $[Co(NH_3)_5(4\text{-nitropyrazole})](ClO_4)_2$. Synthesis and nitration were also studied. (DLC)

37392 **(DOE/ER/04987—8) Solid state, surface and catalytic properties of oxides: Final report.** Kung, H.H. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering). 19 Jul 1987. Contract AC02-78ER04987. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012204.

Two areas of oxide catalysis had been studied. In the first area, the relationship between the reactivity and the surface atomic arrangement was studied using single crystal ZnO surfaces and surface science techniques. It was demonstrated for the first time that the ability of ZnO to decompose methanol depended strongly on the crystallographic orientation of the surface. Evolution of Zn atoms at temperatures much lower than the sublimation temperature was observed. In the second area, the oxide properties that affect selectivity in the oxidative dehydrogenation of hydrocarbons were investigated. The selective dehydrogenation of butene to butadiene on iron oxide was studied to understand the effect of crystallite size and crystallographic form. The dehydrogenation of alkanes was studied on various vanadate catalysts. The importance of groups and of the acidic or basic properties of the surface was investigated. Based on these and other results in the literature, a set of requirements for selective oxidation catalysts was formulated.

37393 **(DOE/ER/13295—T1) Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987.** Sen, Ayusman. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1987. Contract FG02-84ER13295. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011661.

Focus of the research has been in the area of homogeneous catalysis. The catalysis of organic transformations by soluble transition metal compounds has gained widespread attention because of the high efficiency, high specificity and low energy demands often associated with such systems. During the grant period work was performed in four broad areas: the palladium(II) and rhodium(I) catalyzed copolymerization and cooligomerization of carbon monoxide with olefins that lead to the formation of unique polyketones with strictly alternating structures, the reaction chemistry of palladium(II)-acyls including the insertion of olefins into the palladium(II)-acyl bond, and the isomerization of palladium(II)-acyls that led to the discovery of a novel palladium(II) catalyzed process for the isomerization of carboxylic acid chlorides, the synthesis and reactivity of α-ketoacyl and acylalkoxycarbonyl complexes of palladium(II) and platinum(II) - possible models for the intermediates involved in the palladium(II) catalyzed "double carbonylation" reactions and, the reactivity of electrophilic, weakly solvated, cationic palladium(II) compounds and their monoalkyl derivatives vis-a-vis olefins and arenes.

37394 **(DOE/ER/13327—2) Studies of metal ammonia interactions with aromatic substrates: Progress report for the period February 1, 1987 to December 31, 1987.** Rabideau, P.W. (Indiana Univ.-Purdue Univ., Indianapolis (USA)). Jul 1987. Contract FG02-85ER13327. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011197.

This report details the accomplishments since the previous report which was submitted for the activities of 1986. A brief description is provided relating to publications and presentations. Technical work in progress which is not available in reprint form is also described. This includes metal-ammonia reduction results, NMR analysis of hydroaromatics and theoretical calculations on hydroaromatics anions.

37395 **(DOE/ET/33075—T1) Picosecond studies of multiphoton absorption: Final technical report.** Clark, J.H. (California Univ., Berkeley (USA). Dept. of Chemistry). [1987]. Contract AT03-80ET33075. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011199.

Because of experimental difficulties, a project intended to be a study of vibrational energy redistribution turned into a study in laser design. The project was successful, as the laser in its final form was much more reliable than it had been originally. The specific vibrational redistribution experiment originally proposed suffered from several difficulties. A series of molecular beam experiments involving dihaloethane molecules were undertaken.

37396 **(DOE/PC/70777—T2) Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986.** Sczurko, J.J.; Luthy, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). Apr 1987. Contract FG22-84PC70777. 82p. NTIS, PC A05. File Number DE87011198.

The principal objective of this investigation is to develop scientific understanding of the surface reactions that effect the sorption of nitrogen-heterocyclic compounds onto natural minerals. Adsorption phenomena may significantly influence the transport and ultimate fate of organic compounds on land and in aquatic systems. The concepts developed in this study provide a basis for evaluating the surface and solution reactions that control the sorption of nitrogen-heterocyclic compounds in groundwater environments. This work also serves as a basis for design of additional experiments in follow-up studies on the interactions between aromatic solutes and mineral media. Because of compound ionization and electrostatic effects, simple models which emphasize "hydrophobic" interactions to describe sorption of organic compounds are not appropriate for the nitrogen-heterocyclic compounds investigated in this study. Ligand exchange models which interpret the specific adsorption (binding mechanisms other than coulombic) of organic ligands to hydrous oxide surfaces as ligand exchange reactions at reactive surface sites are more appropriate for ionizable nitrogen-heterocyclic compounds. In order to fully understand the behavior of nitrogen-containing aromatic organics in systems containing inorganic solid phases such as metal oxides, additional work is needed to characterize surface binding phenomena and chemical oxidation mechanisms. 40 refs., 23 figs., 10 tabs.

**37397 (IS-T—1292) [Production and reactions of substituted dihydrofurans and thiophenes].** Huang, Y.J. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011254.

Results of Section I not only unambiguously support the previous proposed two-step mechanism for the dimerization of 2,3-dimethylene-2,3-dihydrofuran (1), they also provide two of the most unreactive o-quinodimethanes, namely, 2-methylene-3-t-butylmethylene-2,3-dihydrofuran (2) and 2,3-di-t-butylmethylene-2,3-dihydrofuran. In Section II, the preparation and the dimerization of a series of alkyl ring-substituted and carbomethoxy ring-substituted derivatives of 1 are presented. This study concludes that bulky alkyl substituents on the ring of furan monomers do not promote the [4+2] dimerization process. In Section III, a Diels-Alder reaction of 1 and its two deuterated analogues with methyl acrylate reveals the presence of a secondary deuterium isotope effect which strongly supports a stepwise mechanism. This conclusion is further strengthened by the fact that the Diels-Alder reaction of 1 with cis dienophiles proceeds non-stereo-specifically. A comparison study of o-xylylene with dienophiles reaches the same conclusion. Section IV presents a convenient synthesis of cyclooctadecane from the thiophene trimer of 2,5-dimethylene-2,5-dihydrothiophene.

**37398 (IS-T—1293) Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis.** Lee, S.K. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87011255.

The intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans have been investigated through the pyrolysis of 2-alkenyl-3-furylmethyl benzoates. Under FVP conditions each of the 2,3-dimethylene-2,3-hydrofurans can undergo an intramolecular Diels-Alder reaction or 1,5-hydrogen shift to give the corresponding tricyclics 4c,t, 5c,t, and 6c,t and 1,5-hydrogen shift products 36c,t and 37c,t. FVP of 1,5-dibenzocyclooctadienes containing heteroatoms and dibenzosuberanes gave the corresponding tricyclic compounds [benzodifuran, acridine, and anthracene] except 6H,11H-dibenzo[b,f] [1,4]-dioxocin. FVP of the latter gave (2-hydroxybenzyl)-o-benzaldehyde as a major product. A mechanistic study of the regiospecific formation of 9-methylanthracene from the sealed tube pyrolysis the [4 + 4] dimer of o-xylylene is presented. A new method of preparing cyclopentadienones by the pyrolysis of cyclic diethers is presented. Cyclopentadienones including inden-2-one have been utilized in the synthesis of polycyclic compounds.

**37399 (IS-T—1294) [Dimerization of o-quinodimethanes].** Macias, J.R. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011256.

Using stopped-flow uv-visible spectroscopy, it was determined that the dimerization of o-xylylene (1) follows second-order kinetics with a rate constant of 9.94 +- 0.32 x $10^3$ liter $mol^{-1}$ $s^{-1}$ at 25°C in $CH_3CN$. Two ring-alkylated derivatives of 1, 4-butyl-1,2-xylylene (28) and 3,4-(1,1,3,3-tetramethyltrimethylene)-1,2-xylylene (29) were generated and observed by uv-visible spectroscopy. The rate constant for the dimerization of 28 was 3.90 +- 0.15 x $10^3$ liter $mol^{-1}$ $s^{-1}$ at 25°C and that for 29 was 5.59 +- 0.21 x $10^3$ liter $mol^{-1}$ $s^{-1}$ at 25°C. The similar rate constants indicate that when undergoing dimerization the o-quinodimethane monomers prefer a non-endo approach. The dimerization kinetics of 5-ethylidene-6-methylene-1,3-cyclohexadiene (9) and 5,6-bis(ethylidene)-1,3-cyclohexadiene (10) were studied by stopped-flow uv-visible spectroscopy. At 25°C in $CH_3CN$ $k_9/k_1 = 0.59$ and $k_{10}/k_1 = 0.016$. The dimerization of 9 and 10 led predominantly to one stereoisomer. The rate constants indicated a stepwise mechanism for the dimerization of benzenoid o-quinomethanes. The fluoride-ion induced 1,4-elimination methodology used in the generation of o-xylylene (1) was used to form 1,2-napthoquinodimethane (2) and 9,10-phenanthroquinodimethane (3). o-Quinodimethane (2) was observed in solution by uv-visible spectroscopy while 3 was observed by $^1H$ NMR spectroscopy. Both of these species were considerably more stable than 1, with $k_1/k_2 = 163$ and $k_1/k_3 = 590{,}000$ at 25°C. Both 2 and 3 dimerized following second-order kinetics.

**37400 (LA-UR—87-1739) Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane.** Coburn, M.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-8705144—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010129.

From 6. annual working group meeting on symthesis of high energy density materials; Kiamesha Lake, NY, USA (19 May 1987).

Dimethyldioxirane (DMD) reacted with 3-amino-4-(4-chlorophenyl)furazan (1) to yield 3-(4-chlorophenyl)-4-nitrofurazan (5). DMD reacted with the dimethylsulfilimine of 1 to give the sulfoximine with some 5. Treatment of the trioctylphosphine imine (3) with DMD gave only 5. Other reactions with DMD were studied, including the oxidation of aminofurazans. (DLC)

**37401 (LBL—22992) Two dimensional NMR of liquids and oriented molecules.** Gochin, M. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012137.

Chapter 1 discusses the quantum mechanical formalism used for describing the interaction between magnetic dipoles that dictates the appearance of a spectrum. The NMR characteristics of liquids and liquid crystals are stressed. Chapter 2 reviews the theory of multiple quantum and two dimensional NMR. Properties of typical spectra and phase cycling procedures are discussed. Chapter 3 describes a specific application of heteronuclear double quantum coherence to the removal of inhomogeneous broadening in liquids. Pulse sequences have been devised which cancel out any contribution from this inhomogeneity to the final spectrum. An interpretation of various pulse sequences for the case of $^{13}C$ and $^1H$ is given, together with methods of spectral editing by removal or retention of the homo- or heteronuclear J coupling. The technique is applied to a demonstration of high resolution in both frequency and spatial dimensions with a surface coil. In Chapter 4, multiple quantum filtered 2-D spectroscopy is demonstrated as an effective means of studying randomly deuterated molecules dissolved in a nematic liquid crystal. Magnitudes of dipole coupling constants have been determined for benzene and hexane, and their signs and assignments found from high order multiple quantum spectra. For the first time, a realistic impression of the conformation of hexane can be estimated from these results. Chapter 5 is a technical description of the MDB DCHIB-DR11W parallel interface which has been set up to transfer data between the Data General Nova 820 minicomputer, interfaced to the 360 MHz spectrometer, and the Vax 11/730. It covers operation of the boards, physical specifications and installation, and programs for testing and running the interface.

**37402 (LBL—23579) The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory.** Lee, T.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 170p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012031.

Formulae are derived for the configuration interaction (CI) energy gradient where the CI is based upon a two-configuration self-consistent-field (TCSCF) reference wave function. A derivation of the analytic CI energy second derivative is presented in Chapter III. The third development topic studied is the analytic energy gradient for the externally contracted configuration interaction correlation method. A general discussion about the most efficient gradient technique for any conventional type of electron correlation procedure is presented. Also, the advantages of using derivative theory in the computation of static molecular properties are enumerated. Chapter V contains several chemical applications of the methods. Among these examples are the prediction of the infrared spectrum of $HCNH^+$, $NNOH^+$, $C_2H_3^+$, $C_2H_5^+$ and HSOH. Theoretical predictions of the radiative decay lifetimes of the excited bending levels of $CH_3^-$ are contrasted with the recently measured values. The last application concerns the effects of including triple and quadruple excitations in the CI expansion and allows the general structure of the CI Hamiltonian matrix to be deduced. Finally, the author presents his views on the field of ab initio quantum chemistry and the direction in which it is headed.

37403 (LMF—115, pp 48-52) **In vitro dissolution studies of beryllium aerosols.** Finch, G.L.; Mewhinney, J.A.; Eidson, A.F.; Hoover, M.D.; Rothenberg, S.J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The in vitro dissolution characteristics of beryllium oxide calcined at either 500° or 1000° was studied in two different solvents, 0.1 N HCl and simulated serum ultrafiltrate. Simulated serum ultrafiltrate was employed to model dissolution in lung fluids, and HCl was used to examine dissolution kinetics during the one month period of the study. Although both types of beryllium oxide were found to be relatively insoluble, beryllium oxide calcined at 500°C had greater specific surface area and exhibited increased dissolution rates in both solvents compared to beryllium oxide calcined at 1000°C. Data obtained in this study are of value in related studies analyzing the biokinetics and toxicity of beryllium in Beagle dogs exposed by inhalation to beryllium oxide. 3 references, 1 figure, 3 tables.

37404 (LMF—115, pp 53-57) **Relation of beryllium oxide properties to dissolution in vitro.** Eidson, A.F.; Fitzgerald, S.; Finch, G.L.; Hoover, M.D.; Rothenberg, S.J.; Mewhinney, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The dissolution of BeO calcined at 500°C or 1000°C in 0.1 M HCl and simulated serum ultrafiltrate (SUF) were measured at 30°C, 37°C, 50°C, and 70°C. The molar surface areas and mean crystallite sizes were measured for both forms to investigated the relative contribution of structural defects and surface area on dissolution rate. Dissolution of both BeO forms was negligible in SUF. The pH of the dissolution medium was the most important factor influencing the BeO dissolution rate. Dissolution in 0.1 M HCl was shown to be more closely related to molar surface area than to mean crystallite size. 8 references, 3 figures, 2 tables.

37405 (NP—7770111) **Optimisation of a membrane cell cascade for chlorine alkali electrolysis under the aspect of energy consumption.** Akin, M.R. (Dortmund Univ. (Germany, F.R.). Abt. Chemietechnik). 21 Dec 1984. 160p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770111.

In chlorine alkali electrolysis by the membrane process, cation exchanger membranes with sulphonic acid groups as ion exchangers consume more energy as the soda bye concentration in the catholyte increases. Newly developed two-layer membranes with sulfonic acid groups on the anolyte side and carbonic acid groups on the catholyte side reduce the energy consumption, but this advantage is counteracted by a higher sensitivity to acids of these membranes. Especially if excess HCl is to be removed by electrolysis, it is therefore still of interest to use the more robust membranes of the pure sulfonic acid type instead of the 'high-sophisticated' membranes containing sulfonic acid and carboxyl groups. The author presents mathematical model equations describing the performance of older (Nafion 390) and modern (Nafion 901) membranes under different operating conditions.

37406 (PNL-SA—14400) **Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C.** Theander, O.; Nelson, D.A.; Hallen, R.T. (Pacific Northwest Lab., Richland, WA (USA); Swedish Univ. of Agricultural Sciences, Uppsala. Dept. of Chemistry and Molecular Biology). Oct 1986. Contract AC06-76RL01830. 7p. (CONF-870410—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011152.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Research was initiated to study the competition between the formation of phenolic compounds (aldol involvement) and that of furans (dehydration and cyclization). Hydrothermolytic (liquefaction) conditions, 5 to 7.5 minutes at 300°C, were chosen to examine the effect on potential biomass materials while exposed to mild acid. Results show that phenolic products may be obtained by the acidic hydrothermolysis of xylose and glucuronic acid-containing materials. The phenolics and 2-furaldehyde could contribute to the inhibition of fermentation organisms if acid pretreatment procedures are not controlled carefully. (DLC)

37407 (SAND—87-1402C) **Silicate precursors: chemical kinetics.** Kay, Bruce D.; Assink, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8706123—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010513.

From Topical symposium on recent developments in ceramic science; Albuquerque, NM, USA (17 Jun 1987).

This study employed high resolution $^{29}Si$ NMR spectroscopy to measure the time evolution of the chemical species in the acid catalyzed $Si(OCH_3)_4$:$CH_3OH$:$H_2O$ sol-gel system. Results support a theoretical model in which the reaction kinetics are described by three functional group rate constants and appropriate statistical factors.

37408 (SAND—87-1654C) **Synthesis, structure and properties of BEDT-TTF derivatives.** Nigrey, P.J.; Morosin, B.; Kwak, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870682—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011313.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

Because of the unique transport properties of charge-transfer (C-T) complexes based on the $\pi$-electron donor molecules, 4,5,4',5'-Bis(alkyldithio)-tetrathiafulvalene, the properties of partially selenium substituted donors bis(alkyldiseleno)-tetrathiafulvalene (BADSe-TTF) were investigated. This paper reports the synthesis of one member of these partially selenium substituted donor molecules, BMDSe-TTF, some structural data for the organometallic compound, $(Bu_4N)_2[Ni(dsit)_2]$, which is the precursor to the BADT-TTF donors, and the pressure dependence of conductivity in the C-T salt, $(BMDT\text{-}TTF)_2Au(CN)_2$.

37409 **Structure, stability, and fragmentation of small carbon clusters.** Raghavachari, K.; Binkley, J.S. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Chemical Physics;* **87**: No. 4, 2191-2197(15 Aug 1987).

Accurate ab initio calculations are performed to study the structures and energies of small carbon clusters (C/sub n/, n = 2—10). The effects of polarization functions and electron correlation are included in these calculations. Significant odd—even alternation is found in the nature of the cluster geometries with the odd-numbered clusters having linear structures and many of the even-numbered clusters preferring cyclic structures. Energetically, odd-numbered clusters (up to $C_7$) are found to be more stable than the adjacent even-numbered clusters. Ionization potentials are calculated and used in conjunction with the cluster energies to explain the fragmentation behavior of small carbon cluster ions.

37410 **Rapid heating of gas/small particle mixture.** Wang, K.Y.; Yuen, W.W. (Corporate Research and Development, General Electric Co., Schenectady, NY 12345). *Journal of Solar Energy Engineering;* **109**: No. 2, 143-149(May 1987).

The concept of using a mixture of particles and air as a medium to absorb radiative energy has been proposed for various applications. In this paper, carbon particles mixed with gas form a medium that absorbs radiation from sources such as concentrated solar energy. A single-particle, two-temperature model is used to study the transient temperature of the particle/gas mixture as it undergoes a constant pressure expansion process. The results indicate that for particles smaller than 1 $\mu$m in diameter, the surrounding air can be heated as quickly as the particles, while for particles larger than 1 mm in diameter, the air temperature stays relatively unchanged and the particles are heated to a very high temperature.

37411 **Vapor-liquid equilibria of sulfur dioxide in polar organic solvents.** Demyanovich, R.J.; Lynn, S. (Dept. of Chemical Engineering, Univ. of California, Berkeley, CA). *Industrial and Engineering Chemistry Research;* **26**: No. 3, 548-554(Mar 1987).

Vapor-liquid equilibrium data for SO/sub 2/ in eight polar organic solvents and three mixtures of organic solvents were investigated over the temperature range 30-95°C and over a concentration range of 0.02-0.16 weight fraction of SO/sub 2/. The solvents investigated were N, N-dimethylaniline (DMA); quinoline; the dimethyl ethers of diethylene glycol, triethylene glycol, and tetraethylene glycol; the monomethyl ether of diethylene glycol (DGM); tetramethylene sulfone; and tributyl phosphate. The mixed solvents investigated were various mixtures of DMA and DGM. The data were correlated by using the UNIQUAC, NRTL, Wilson, and Henry's law phase-equilibrium models.

37412 **Activation and promotion studies in a mixed slurry reactor with an iron-manganese Fischer-Tropsch catalyst.** Pennline, H.W.; Zarochak, M.F.; Stencel, J.M.; Diehl, J.R. (Pittsburgh Energy Technology Center, US Dept. of Energy, Pittsburgh, PA). *Industrial and Engineering Chemistry Research;* **26**: No. 3, 595-600(Mar 1987).

Synthesis gas was reacted over a coprecipitated iron-manganese Fischer-Tropsch catalyst in a slurry reactor. The effect of various activation parameters - temperature, pressure, and gas composition - on subsequent catalyst activity and product selectivity was investigated. The gas composition had the most dramatic effect on the catalyst activation and the ensuing synthesis gas conversion. The effect of potassium promotion on catalyst activity and product selectivity was also studied in slurry reactor tests.

37413 **Temperature-dependent parameters and the Peng-Robinson equation of state.** Xu, Z.; Sandler, S.I. (Jiao Tong Univ., Sian). *Industrial and Engineering Chemistry Research;* **26**: No. 3, 601-605(Mar 1987).

Parameters obtained from supercritical volume data and subcritical saturated liquid volumes and vapor pressures are reported for nine hydrocarbons, argon, oxygen, nitrogen, carbon monoxide, carbon dioxide, water, and methanol. These new parameters are correlated as a function of reduced temperature in the subcritical and supercritical temperature range and as a cubic-spline function in the near-critical region. Remarkably good predictions are obtained for the volumes and saturated vapor pressures of the pure components studied by using the Peng-Robinson equation with the proposed parameters. The predictions are much better than those obtained with the standard, generalized Peng-Robinson parameters.

37414 **Physiological pH fiber-optic chemical sensor based on energy transfer.** Jordan, D.M.; Walt, D.R.; Milanovich, F.P. (Tufts Univ., Medford, MA). *Analytical Chemistry;* **59**: No. 3, 437-439(1 Feb 1987).

A fiber-optic sensor has been developed containing a fluorophore, eosin, and an absorber, phenol red, coimmobilized on the distal end of an optical fiber. When an argon laser is used to excite eosin with light of λ 488 nm, a region of the spectrum where phenol red does not absorb, eosin emits light in a spectral region that overlaps significantly with the absorption spectru of the basic form of phenol red. Consequently, nonradiative energy transfer occurs from eosin (donor) to phenol red (acceptor). The amount of energy transfer increases as the pH increases resulting in a diminished fluorescence intensity. Thus, changes in the absorption of phenol red as a function of pH are detected as changes in the fluorescent signal. In this manner a pH sensor optimized for physiological pH measurement has been prepared. The fiber exhibits a precision of at least 0.01 pH units.

37415 **Critical review of the foam rheology literature.** Heller, J.P.; Kuntamukkula, M.S. (Petroleum Recovery Research Center, New Mexico Institute of Mining and Technology, Socorro, NM 87801). *Industrial and Engineering Chemistry Research;* **26**: No. 2, 318-324(Feb 1987).

The rheology of foam is not like that of simpler fluids which can be regarded as mathematical continua. The difference arises because the size of foam bubbles is not infinitesimal relative to the width of the flow channels and because foam (whether gas-in-liquid or liquid-in-liquid) contains a high volume fraction (in excess of 74% for a monodisperse system) of the discontinuous phase. Special emphasis is given to recent work that evaluates the critical yield stress in idealized cases and makes is possible to relate measured apparent viscosities of foams in large channels to a usually unmeasured boundary effect.

37416 **Transport properties of isobutane.** Nieuwoudt, J.C.; Le Neindre, B.; Tufeu, R.; Sengers, J.V. (Institute for Physical Science and Technology, Univ. of Maryland, College Park, MD). *Journal of Chemical and Engineering Data;* **32**: No. 1, 1-8(Jan 1987).

Representative equations are presented for the viscosity and thermal conductivity of isobutane as a function of temperature and density. The equations are based on existing experimental data for the viscosity and new experimental data for the thermal conductivity of isobutane. The possible use of isobutane as a working fluid in binary geothermal power cycles is discussed.

37417 **Solubilities of higher normal alkanes in m-xylene.** Beiny, D.H.; Mullin, J.W. (Dept. of Chemical and Biochemical Engineering, Univ. College London, Torrington Place, London WC1E 7JE). *Journal of Chemical and Engineering Data;* **32**: No. 1, 9-10(Jan 1987).

The solubilities of n-octacosane (n-C/sub 28/H/sub 58/), n-dotriacontane (n-C/sub 32/H/sub 66/), and n-hexatriacontane (n-C/sub 36/H/sub 74/) in m-xylene have been measured over the temperature range 11.7-38.6°C. Although the entropies and enthalpies of dissolution are higher than the corresponding values for short-chain alkane solvents, the present data are still well described by the parametric van't Hoff equation.

37418 **Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative.** Leet, W.A.; Lin, H.M.; Chao, K.C. (School of Chemical Engineering, Purdue Univ., West Lafayette, IN). *Journal of Chemical and Engineering Data;* **32**: No. 1, 37-40(Jan 1987).

Mutual solubilities at the three-phase vapor-liquid-liquid equilibrium pressure were experimentally determined for the binary mixtures of water with m-cresol, quinoline, indoline, 1,2,3,4-tetrahydroquinoline (THQ), thianaphthene, or 9,10-dihydrophenanthrene at temperatures from 293 to 502 K. The equilibrium compositions of both liquid phases, temperature, and three-phase equilibrium pressure are reported.

37419 **Excess molar enthalpies for the 1-butanol-benzene-cyclohexane system at 25°C.** Tamura, K.; Nagata, I. (Dept. of Chemical Engineering, Kanazawa Univ., Kanazawa 920). *Journal of Chemical and Engineering Data;* **32**: No. 1, 45-47(Jan 1987).

Excess molar enthalpies at 25°C were measured for 1-butanol-benzene-cyclohexane by use of an isothermal dilution calorimeter. The experimental results were well correlated with the UNIQUAC associated-solution model, which includes the dimerization constant and the constant for formation of higher polymers for the alcohol, and one solvation constant between the alcohol and benzene and binary interaction parameters.

37420 **Thermal conductivities of ternary liquid mixtures.** Rowley, R.L.; White, G.L. (Dept. of Chemical Engineering, 350 CB, Brigham Young Univ., Provo, UT). *Journal of Chemical and Engineering Data;* **32**: No. 1, 63-69(Jan 1987).

A new, transient, hot-wire thermal conductivity cell has been constructed, calibrated against pure liquid toluene, and used to measure mixture thermal conductivity values in six ternary systems at 298 K and ambient pressure. These data have been used to test the accuracy of commonly used models/correlations that are both predictive in nature and extendable to multicomponent systems. For these six systems, the order of model accuracy was power law, local composition, LI, and ideal equations.

37421 **Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures.** Phutela, R.C.; Pitzer, K.S.; Saluja, P.P.S. (Dept. of Chemistry and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *Journal of Chemical and Engineering Data;* **32**: No. 1, 76-80(Jan 1987). Contract AC03-76SF00098.

Heat capacities and densities of aqueous MgCl/sub 2/, CaCl/sub 2/, and SrCl/sub 2/ from the accompanying paper are combined with literature data up to 473 K to yield temperature-dependent equations by using the ion-interaction model of Pitzer. These heat capacity equations have been integrated to yield the enthalpy and the Gibbs energy. The enthalpy parameters for 298 K are evaluated in separate calculations using published high-temperature osmotic data as well as heats of dilution, while the Gibbs energy parameters for 298 K are taken from the literature. The range of validity of the final equations is described.

37422 **Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C.** Rard, J.A.; Miller, D.G. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA). *Journal of Chemical and Engineering Data;* **32**: No. 1, 85-91(Jan 1987). Contract W-7405-ENG-48.

The osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ have been determined at 25°C by using the isopiestic method. These measurements extend from low concentrations to the crystallization limits of the mixtures. They are critically compared to published isopiestic, direct vapor pressure, and emf data for this system. The data agree well with previous isopiestic data and two sets of emf values, but direct vapor pressure data are significantly discrepant. Osmotic and activity coefficients for NaCl-MgCl/sub 2/ mixtures are fairly reliably represented by both Pitzer's equations and Scatchard's neutral electrolyte equations.

37423 **Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C.** Rard, J.A. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA). *Journal of Chemical and Engineering Data;* **32**: No. 1, 92-97(Jan 1987). Contract W-7405-ENG-48.

The osmotic coefficients of aqueous La(NO/sub 3/)/sub 3/ have been measured from 1.3435 to 8.4591 mol.kg/sup -1/ at 25°C by using the isopiestic method. Some earlier osmotic coefficients for this salt are too high, apparently due to a stock solution concentration error, and have been normalized to the present results. These combined data and other activity data were then used to generate recommended values for the osmotic coefficients, water activities, and mean molal activity coefficients of La(NO/sub 3/)/sub 3/. The solubility of La(NO/sub 3/)/sub 3/.6H/sub 2/O(cr) was determined to be 4.6147 +- 0.0056 mol.kg/sup -1/ by the isopiestic method; this is in excellent agreement with the IUPAC recommended value of 4.610 +- 0.005 mol.kg/sup -1/. Density data were measured for aqueous Eu(NO/sub 3/)/sub 3/ from 0.03996 to 1.1014 mol.kg/sup -1/ at 25°C by using pycnometry.

37424 **Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-β-alkenyl-8-hydroxyquinoline/xylene system.** Savastano, C.A.; Bapat, P.M.; Lee, C.K.; Tavlarides, L.L. (Imperial College of Science and Technology, London SW7 2AY). *Industrial and Engineering Chemistry Research;* **26**: No. 1, 117-124(Jan 1987).

The performance of a continuous-flow stirred tank hydrometallurgical extractor has been simulated. Two models are used for such simulations: a noninteraction model based on macroscopic material balances and an interaction model featuring a stochastic treatment of the microscopic hydrodynamics of the dispersion. The models incorporate equilibrium and intrinsic kinetic expressions pertaining to chemical system of hydrometallurgical interest: iron(III) sulfate-β-alkenyl-8-hydroxyquinoline/xylene. Comparison between the model predictions and the experimental results indicates the interaction model to be more accurate than the noninteraction model.

37425 **Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts.** Cocco, R.A.; Koo, Y.J.; Tatarchuk, B.J. New York, NY; American Institute of Chemical Engineers (1986). 23p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Recent studies in the authors' laboratory have demonstrated the ability to prepare sulfided ruthenium catalysts which have high inherent activities while also possessing adjustable hydrogenation to hydrogenolysis ratios. Since adjustable selectivities are not presently provided by commercial hydrotreating catalysts, additional XPS, kinetic, following presulfidization in 100% H/sub 2/S at temperatures greater than 623K. Transition from one selectivity regime to another was readily and reversibly achieved following appropriate annealing or sulfidization treatments as evidenced by both XPS and kinetic/selectivity measurements.

37426 **Raman spectroscopic studies of titanium alkoxides using UV excitation.** Payne, M.J.; Berglund, K.A. (Michigan State Univ., East Lansing, MI). pp 627-632 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The use of Raman spectroscopy can be greatly hindered by the presence of fluorescing impurities. Even at low concentrations, fluorescence can completely obscure the Raman signal. In the current study, Raman spectra were recorded for various titanium alkoxides (ethoxide, isopropoxide, isobutoxide) as a function of concentration and laser excitation wavelength. It has been shown that fluorescence can be avoided by using uv-excitation (363.8 nm). In addition, titanium alkoxides exhibit a preresonance Raman enhancement as the excitation wavelength approaches the UV. This result is confirmed by a uv-visible absorption spectrum of the isopropoxide.

37427 **Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates.** Balfe, C.A.; Ward, K.J.; Tallant, D.R.; Martinez, S.L. (Sandia National Labs., Albuquerque, NM). pp 619-626 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The kinetics of hydrolysis of hexamethylcyclotrisiloxane and di-t-butyldimesitylcyclodisiloxane in tetrahydrofuran solution have been determined and compared to hydrolysis rates of silica defects. In the presence of sufficient excess water, the first-order rate constant of the cyclotrisiloxane, k = 3.8 x 10/sup -3/ min/sup -1/ is similar to the rate constant, k = 5.2 x 10/sup -3/ min/sup -1/, of the disappearance of the D2 Raman silica defect band it has been proposed to model. Limited hydrolysis rate data for the cyclodisiloxane suggests that it hydrolyzes at least four times faster than does the cyclotrisiloxane. These data are consistent with rate data available for silica crack growth and support the assignment of highly strained siloxane bonds at the crack tip to cyclodisiloxanes.

37428 **Particle compaction with alternating electric fields: The effects of electrode geometry.** Hurd, A.J. (Sandia National Labs., Albuquerque, NM). pp 345-350 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

A technique for inducing ordered, close-packed arrangements of various symmetries among colloidal particles is discussed. An external alternating electric field applied to the colloid induces dipole interactions of variable strength by polarizing either the dielectric material of the particles or their electrostatic double layers. Ordering in various symmetries can be obtained by switching the

field rapidly between pairs of electrodes, thereby changing the orientation of the induced dipoles. A small dc bias serves to deposit and compact the aligned particles.

37429 **Growth and structure of fractally rough silica colloids.** Keefer, K.D. (Sandia National Labs., Albuquerque, NM). pp 295-304 of Better ceramics through chemistry II. Brinker, C.J.; Clark, D.E.; Ulrich, D.R. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—). Contract AC04-76DP00789.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Small-angle x-ray scattering measurements on partially hydrolyzed silicon tetraethoxide solutions indicate the formation of colloidal particles which have fractal structures or fractally rough surfaces. The structures and growth kinetics are consistent with chemically limited nucleation and growth of the particles from slowly generated reactive silanol species. Two dimensional computer simulations of nucleation and random growth of clusters from partially hydrolyzed monomers generate the same range of nonfractal, fractally rough and fractal clusters observed in the experiment.

37430 **Theoretical modeling and laser diagnostics of silicon chemical vapor deposition.** Coltrin, M.E.; Breiland, W.G.; Ho, P. New York, NY; American Institute of Chemical Engineers (1985). 6p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC04-76DP00789.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

88C.

The authors have developed a numerical model of the coupled gas-phase chemical kinetics and fluid mechanics in the Chemical Vapor Deposition (CVD) of silicon from silane. The model includes 29 chemical reactions describing the thermal decomposition of silane and predicts gas-phase concentration profiles of 17 chemical species as a function of susceptor temperature, carrier gas, pressure, flow rate. The model also predicts gas-phase temperature and velocity fields, deposition rates and deposition uniformity. Comparisons are made between model predictions and in situ measurements of gas-phase temperatures, and density profiles of SiH/sub 4/ and Si/sub 2/. Agreement between theory and experiment is generally good.

## 4004 Electrochemistry

*REFER ALSO TO CITATION(S) 36948, 37428*

37431 **Absolute half-cell potential: A simple direct measurement.** Hansen, W.N.; Hansen, G.J. (Department of Physics, Utah State University, Logan, Utah 84322). *Physical Review [Section] A: General Physics;* **36**: No. 3, 1396-1402(1 Aug 1987).

The concept of the absolute half-cell potential is discussed from a simple thermodynamic point of view and defined as -ΔG/ne for the half-cell reaction, treating the electron like other individual chemical species. With the standard reference state of the electron taken as the free electron at rest at infinity, the absolute half-cell potential is simply the Fermi level of the electrons in the half-cell lead wire. This potential can be simply measured with a Kelvin probe by determining the vacuum potential level over the electrolyte relative to the Fermi level of the half-cell lead. Since the probe cannot determine potentials absolutely, it must be calibrated using a material whose work function is known. Using this procedure we obtain for the standard hydrogen half-cell, E/sub abs/(SHE) = 4.456 +- 0.025 eV, assuming our Hg as used in calibration has a work function of 4.495 eV.

## 4005 Photochemistry

*REFER ALSO TO CITATION(S) 37662*

37432 **(DOE/ER/03416—48) The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987.** Lampe, F.W. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1987. Contract AC02-76ER03416. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011926.

The following were studied: infrared laser photochemistry of $SiH_4$-$D_2$ mixtures; insertion of $SiH_2$ into $GeH_4$; infrared laser photochemistry of $CH_3SiH_3$-HCl mixtures; reaction of $GeH_3$ radicals with NO; and reactions of $Si^+$ ions with methylsilane and ethane. (DLC)

37433 **Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene.** Kamat, P.V. (Univ. of Notre Dame, IN). *Analytical Chemistry;* **59**: No. 13, 1636-1638(1 Jul 1987).

The cationic polymerization of 9-vinylanthracene can be initiated at a transparent $SnO_2$ electrode with the application of anodic potentials (E > 1.1 V vs. saturated sodium chloride calomel electrode) in acetonitrile solutions. The excimer emission (emission maximum ~500 nm) of poly(9-vinyl-anthracene) which is distinguishable from the monomer fluorescence emission (emission maxima 410, 430 nm) has been used to probe the electrochemical polymerization process directly. The in situ spectroelectrochemical technique, which would be useful in obtaining kinetic and mechanistic information of the electropolymerization process, is described.

## 4006 Radiation Chemistry

37434 **(DOE/ER/13108—T4) Pulse radiolytic studies of inter- and intramolecular electron transfer processes: Progress report.** Neta, P. (National Bureau of Standards, Washington, DC (USA). Chemical Kinetics Div.). 20 Mar 1987. Contract AI05-83ER13108. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012198.

Electron transfer processes have been studied by kinetic spectrophotometric pulse radiolysis. These studies include examination of the mechanisms, rate and equilibrium constants, and activation energies of electron transfer reactions in a variety of chemical systems such as organic radicals and radical ions, inorganic radicals, and metalloporphyrins.

37435 **(DOE/ER/13465—2) Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). Jul 1987. Contract FG05-86ER13465. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009802.

Goal is to study the role of a host lattice in the formation of radicals and excited singlet and triplet states that are relevant to photosynthesis. Particular emphasis is being placed on determining what is special about carotenoids that natural photosynthetic systems require them as antennae as well as for protection. We are thus manipulating the host matrix so as to understand the carotenoid function (protection, quenching, energy transfer and antenna).

## 4007 Radiochemistry And Nuclear Chemistry

*REFER ALSO TO CITATION(S) 36819, 37878*

37436 **(ANL—87-18) Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report.** Kline, W.H.; Fassnacht, G.F.; Moe, H.J. (Argonne National Lab., IL (USA)). Jul 1987. Contract W-31109-ENG-38. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011998.

ANL has decontaminated and decommissioned (D and D) seven radiologically contaminated surplus facilities at its Illinois site: a "Hot" Machine Shop (Building 17) and support facilities; Fan House No. 1 (Building 37), Fan House No. 2 (Building 38), the Pangborn Dust Collector (Building 41), and the Industrial Waste Treatment Plant (Building 34) for exhaust air from machining of radioactive materials. Also included were a Nuclear Materials Storage Vault (Building 16F) and a Nuclear Research Laboratory (Building 22). The D and D work involved dismantling of all process equipment and associated plumbing, ductwork, drain lines, etc. After radiation surveys, floor and wall coverings, suspended ceilings, room partitions, pipe, conduit and electrical gear were taken down as necessary. In addition, underground sewers were excavated. The grounds around each facility were also thoroughly surveyed. Contaminated materials and soil were packaged and shipped to a low-level waste burial site, while nonactive debris was buried in the ANL landfill. Clean, reusable items were saved, and clean metal scrap was sold for salvage. After the decommissioning work, each building was torn down and the site relandscaped. The project was completed in 1985, ahead of schedule, with substantial savings.

37437 **(CONF-870661—7-Vugraphs) Modeling americium separations in stagewise solvent extraction.** Leonard, R.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011445.

From 11. actinide separations conference; Livermore, CA, USA (1 Jun 1987).

The TRUEX solvent includes octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide, TBP, and diluents (NPH, organic halide). Distribution coefficients are given for americium, etc. Worksheets, diagrams, etc. are included. (DLC)

37438 **(ISH—36) Comparative investigations of different measurement methods of Radiochromatograms for the evaluation of the radiochemical purity of ten radiopharmaceuticals.** Hammermaier, A.; Reich, E.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Feb 1984. 105p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-09852.

Other than determining the radiochemical purity of several radiopharmaceuticals, a comparison of the different measuring methods of distributing activity on radiochromatograms or electropherograms is intended by this study. For this, the activity distribution in the developed radiochromatograms was assessed by four different measuring methods (TLC-linear analyzer, DC-scanner with NaI(Tl) detector, DC-scanner with gas flow counter and gamma-sample-counter. As shown by the analysis, only the TLC-linear analyzer and the gamma-sample-counter (measurement of chromatograms or electropherograms cut into strips) are generally suitable methods for determining the radiochemical purity of radiochemicals, the DC-scanner with gas flow counter is usable in most cases, while DC-scanner with NaI(Tl) detector is yielding unsatisfactory results.

37439 **(ISH—48) Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis.** Hammermaier, A.; Reich, E.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Aug 1984. 88p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-09853.

Some marketable I-131/I-125/I-123 o-iodohippuric acids were analysed from March to June 1984 with regard to their radiochemical purity and stability. As method of analysis thin layer chromatography was chosen and as method of measurement a TLC linear analyzer was used. At the same time the in vitro stability of the listed radiopharmaceuticals was taken into consideration. It turned out that the I-131 products are subject to a great decomposition. A comparison drawn from several HPLC-measuring methods showed that the selected method of thin-layer chromatography lead to a far better separation of the radiochemical impurities.

37440 **(ISH—56) Influence of radiation treatment on pharmaceuticals and auxiliary ingredients. A review. Pt. 7.** Schnell, R.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1984. 90p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-09856.

In this bibliographic study, the results of 61 radiation tested pharmaceuticals are discussed and evaluated. The substances were treated with ionizing radiation in their pure form (solid substance or liquid), as aqueous or alcohol solution, as emulsion or in compound form, almost exclusively with gamma radiation from cobalt-60 sources. The radiation doses applied ammounted from some krd to about 100 Mrd.

## 4008 Combustion, Pyrolysis, And High-temperature Chemistry

*REFER ALSO TO CITATION(S) 36278, 36326, 36462, 36464, 37523, 37957*

37441 **(N—87-20399) Theoretical and experimental investigations of ignition, combustion and expansion processes of hypergolic liquid fuel combinations at gas temperatures up to 3000 deg K. Thesis - Rhein-Westfalia Technical Coll., 1967.** Schulz, H. (National Aeronautics and Space Administration, Washington, DC (USA)). Mar 1987. 166p. (NASA-TM—88527; NAS—1.15:88527). NTIS, PC A08/MF A01.

The ignition, combustion, and expansion characteristics of hypergolic liquid propellant mixtures in small rocket engines are studied theoretically and experimentally. It is shown by using the Bray approximation procedure that the reaction $H + OH + M = H_2O + M$ (where M is the molecular mass of the gas mixture) has a strong effect on the combustion efficiency. Increases in recombination energies ranging from 30 to 65% were obtained when the rate of this reaction was increased by a factor of 10 in gas mixtures containing 90% oxygen. The effect of aluminum additions and various injection techniques on the combustion process is investigated.

37442 **(N—87-20780) Remarks on the stability analysis of reactive flows.** Scheurer, B. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Mar 1987. 22p. (NASA-CR—178269; ICASE—87-18; NAS—1.26:178269). NTIS, PC A02/MF A01.

A simple model of compressible reacting flow is studied. First, a dispersion relation is derived for the linearized problem making a distinction between frozen and equilibrium sound speed. Second, the stability of the Von Neumann-Richtmyer scheme applied to this model is studied. A natural generalization of the C.F.L. condition is found.

37443 **(NP—7770122) Safety characteristics of polynary fuel/air mixtures and self-disintegrating substances.** Alfert, F. (Dortmund Univ. (Germany, F.R.). Abt. Chemietechnik). 25 Apr 1985. 202p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87770122.

The aspects discussed in the dissertation are integrated in the safety concept for chemical plants, and theoretical and experimental findings are presented on explosion limits, ignition temperature, limiting gap width/quenching distance, limiting pressure.

37444 **(TKK-KO/ET—16) Calculation of radiation spectrum of non-isothermal gas.** Sirkiae, T. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1986. 64p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752375.

The scope of this work was to develop a method to calculate the radiation spectrum of non-isothermal gas to be used in combustion modeling. The best features of existing methods were selected to be the base of the new method. The band is modeled by Edward's exponent method and equivalent parameters of Cess and Wang are used to take in the account the non-isothermity of the gas. The results calculated by the new method are compared to the results which have been published in the literature. The difference between calculations and the measured values was about 15%. The

results are quite good when comparing to other methods. The new method seems to be better than the original method of Cess and Wang, but some further investigations are needed to evaluate the accuracy of the method.

37445 **Nusselt number correlations for heat transfer to small spheres in thermal plasma flows.** Young, R.M.; Pfender, E. (Univ. of Minnesota, Minneapolis). *Plasma Chemistry and Plasma Processing;* 7: No. 2, 211-229(Jun 1987). Contract FG02-85ER13433.

Seven different equations predicting heat transfer rates to small spheres in plasma flows are examined considering argon and nitrogan as plasma gases from 300 to 21,000 K at 1 atm. For argon there is a general consensus up to 9000 K, beyond which wide deviations in behavior occur. For nitrogen, the seven correlations are in good agreement up to 4000 K, bus show substantial deviations beyond this value. Comparisons with the sparsely available experimental data are made for argon from 300 to 17,000 K and for nitrogen up to 5500 K. Disagreement between the various correlations and experiment can exceed one order of magnitude.

37446 **(ESA-TT—68) Theoretical study of the nonsteady combustion of composite fuel droplets.** Dupoirieux, F. (European Space Agency, 75 - Paris (France)). Nov 1986. Transl. into ENGLISH of Etude Theorique de la Combustion Instationnaire de Gouttes de Combustible Composite' ONERA, Paris, France, report ONERA-NT-1983-3, 1983. (ONERA-NT—1983-3; ETN—87-99424). 121p. NTIS, PC A06/MF A01.

Droplet combustion was constructed based on the following assumptions: the droplet contains two distinct miscible fuels. The unsteady terms are included. The physical properties (thermal conductivity, mass diffusion coefficients) depend on gas phase composition and temperature. The effects of pressure variation are taken into account, with the pressure being either given or computed. Since the combustion is assumed to be spherically symmetrical about the center of the droplet, convection due to a gas phase velocity far from the droplet cannot be taken into account.

# 42 ENGINEERING

*REFER ALSO TO CITATION(S) 36750, 37000*

37447 **(UCID—19080-86) Engineering Research Division publication report, Calendar year 1986.** Holten, M.L.; King, Y.T. (comps.). (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010846.

## 4202 Facilities And Equipment

*REFER ALSO TO CITATION(S) 36340, 36415, 36426, 36801, 37243, 37255, 37325, 37528, 37548*

37448 **(AD-A—179148/2/XAB) Superconducting electronic-film structures. Annual report, 1 January-31 December 1985.** Bragninski, A.I.; Gavaler, J.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 4 Feb 1986. 20p. NTIS, PC A02/MF A01.

Results from niobium/tin and niobium/aluminum diffusion-couple experiments show that oxygen or oxides can have a positive influence on the nucleation and growth of stable as well as metastable A15 phases. Data on the effect of epitaxy and the addition of carbon impurities on the critical temperatures of niobium nitride films deposited at low temperatures show that both are effective in stabilizing the stoichiometric B1 phase. Critical temperatures of 16.4K were obtained in epitaxially grown NbN films deposited on <100C substrates. According to RHEED and X-ray rocking-curve data, high-quality single-crystal films of the technologically important A15 and B1 superconductors, including Nb-Sn, Nb-Ge, and NbN can be reproducibly grown in the new deposition and analytical facility. Low-leakage all-NbN tunnel junctions were developed with ion-beam oxidized Al and M barriers, or rf-sputtered magnsium oxide barriers. The first Nb-Sn based junctions with refractory counterelectrodes were fabricated. XPS, RHEED, and tunneling were used to characterize: 1) the structure of epitaxial films, 2) the role of ion-beam oxidation in the preparation of tunnel barriers that can be used with refractory counterelectrodes, and 3) junctions proceed at temperatures up to 800 C. Nb single crystal films were prepared which have three times lower rf surface losses compared to polycrystalline Nb.

37449 **(AD-A—179164/9/XAB) Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987.** Schwope, A.D.; Costas, P.P.; Jackson, J.O.; Stull, J.O.; Weitzman, D.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1987. 229p. NTIS, PC A11/MF A01.

A variety of protective-clothing items are commercially available for emergency response and other applications where chemical hazards may be encountered. Data and information for selecting chemical-protective clothing is either not available or is inconsistant from source to source. In 1983, the U.S. Environmental Protection Agency sponsored the development of chemical-protective clothing selection guidelines to assist their own Office of Health and Safety in providing guidance to personnel, primarily EPA employees and contractors, working on hazardous-waste sites. These guidelines allowed a user to select an appropriate protective material for a specific chemical, select a clothing item (glove, suit, etc.), and then determine which manufacturers offered the clothing item in the recommended material. The U.S, Coast Guard Office of Research and Development and the EPA have supplemented these guidelines with additional data on material chemical resistance, material physical properties, clothing design features, and specific-vendor products. A chapter has been added for selecting chemical-protective suits. These guidelines contain data for over 750 chemicals and 700 clothing products. Volume I provides performance information and recommendations for selecting different types of protective clothing. Volume II contains a detailed technical discussion, and the data on which Volume I recommendations are based. The U.S. Coast Guard intends to use these guidelines for protective-clothing selection by its National Strike Force and Marine Safety Offices.

37450 **(AD-A—179346/2/XAB) Superconducting thin films, composites & junctions. Annual report, 1 October 1985-30 September 1986.** Geballe, T.H. (Stanford Univ., CA (USA). Dept. of Applied Physics). Dec 1986. 9p. (GL—4157). NTIS, PC A02/MF A01.

Low-energy ion-beam cleaning of the substrates prior to deposition has been found to enhance the quality of ultrathin (< 100A) refractory superconducting niobium, vanadium films. Nb film thin as 7A was grown from which it was possible to fabricate good superconducting tunnel junctions. Both the native films and the tunnel junctions can be thermally recycled without any degradation. In-situ surface studies along with transmission electron microscopy suggest the removal of the carbon atoms from the surface of the substrate and possibly the increased chemical reactivity of the substrate atoms are the causes of the improvement. TEM results indicate that the Nb films grow perfectly lattice matched to the sapphire substrate when the substrate is ion-beam cleaned. This strained-layer epitaxy is observed up to 40A, the maximum thickness investigated through TEM. Good-quality tunnel junctions were fabricated on ultrathin films of Nb. Absolute specific-heat measurements were made through the metal-insulator transition in thin-film molybdenum (X) germanium (1-X) determining the thermodynamic electronic density of states. Nb/tantalum multilayered films prepared by magnetron sputtering were studied by critical-field measurements. The effects of substrate orientation and deposition temperature on properties of the films were determined. Considerable progress was made in design and construction of the new advanced electron-beam-deposition facility.

37451 **(AD-A—179516/0/XAB) Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987.** Schwope, A.D.; Costas, P.P.; Jackson, J.O.; Stull, J.O.; Weitzman, D.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1987. 353p. NTIS, PC A16/MF A01.

See also Volume 2, AD-A179 164.

A variety of protective-clothing items are commerically available for emergency response and other applications where chemical hazards may be encountered. Data and information for selecting chemical-protective clothing is either not available or is inconsistant from source to source. In 1983, the U.S. Environmental Protection Agency sponsored the development of chemical-protective clothing selection guidelines to assist their own Office of Health and Safety in providing guidance to personnel, primarily EPA employees and contractors, working on hazardous-waste sites. These guidelines allowed a user to select an appropriate protective material for a specific chemical, select a clothing item (glove, suit, etc.) and then determine which manufacturers offered the clothing item in the selected material. The U.S. Coast Guard Office of Research and Development and the EPA have supplemented these guidelines with additional data on material chemical resistance, material physical properties, clothing design features, and specific-vendor products. A chapter has been added for selecting chemical protective suits. These guidelines contain data for over 750 chemicals and 700 clothing products. Volume I provides the performance information and recommendations for selecting different types of protective clothing.

37452 **(AD-A—179604/4/XAB) SIS (superconductor-insulator-superconductor) mixer research. Final report, 15 November 1985-14 November 1986.** Feldman, M.J. (Virginia Univ., Charlottesville (USA). Dept. of Electrical Engineering). 17 Mar 1987. 12p. (UVA—525657/EE87/101). NTIS, PC A02/MF A01.

Theoretical and experimental research has been conducted to elucidate the basic physics behind the properties of superconductor-insulator-superconductor (SIS) tunnel junction receiving devices. The quantum theory of mixing was employed to calculate the saturation behavior of the SIS mixer and the SIS direct detector. The direct detector was found to saturate at far higher powers than previously believed, allowing the possibility of practical application of this device. Experiments verified the saturation theory. The mixer saturation expression led to the formulation of frequency-scaling regions. The origin of quantum noise sources are completely minimized. The mixer quantum-noise limit was shown to be reached in only two special cases. Computer calculations determined that the behavior of SIS receivers divides into two regimes, low and high frequencies, the cross-over frequency depending upon junction quality. The properties of these two regimes were delineated. All previous SIS receivers have operated in the low-frequency regime. Plasma-etched niobium nitride edge junctions were fabricated using a novel barrier-formation process. These junctions have excellent current-voltage characteristics, but their precise physical nature has not yet been determined.

37453 **(CONF-870601—9) Shielding methods for evaluating the versatility of proposed shipping casks.** Bucholz, J.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87005684.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

After a shipping cask has been designed for a certain type of spent fuel, the number of assemblies it can carry is fixed, as are the thicknesses of the various steel shells, the neutron shield, and the gamma shield. The question then becomes "What other types of spent fuel may be shipped in the cask?" Using the same neutron and gamma source terms, miscellaneous correlations, and one-group cross sections found in the CAPSIZE program, a fast new interactive shielding program called KWIKDOSE has been written for the IBM-PC which computes and displays a 2-D table showing the total dose rate ten feet from the centerline of a cask, as a function of the spent fuel's burnup and cooling time.

37454 (CONF-8608141—, pp 699-706) **High-precision, low-cost dendrochronograph.** Twery, M.J.; Kim, E.; Vaisnys, R. (Yale Univ., New Haven, CT). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Dendrochronographs, devices to facilitate the recording of measurements of tree rings, are valuable tools in the study of tree growth and various environmental factors which affect that growth. Their cost is often in the range of $30,000, depending on the sophistication of the peripheral equipment. This price puts them out of reach for many laboratories where they might be very useful. The authors have designed and built a device to accomplish all the essential functions of a dendrochronograph using common equipment existing in many laboratories plus new hardware costing only a few hundred dollars. In addition, the authors device has been found to have operational precision better than 0.01 mm, as sensitive as many of the commercial devices. 3 references, 5 figures.

37455 **(CONF-8705113—1) Initial testing and resulting redesign of the 96-inch diameter Robbins Disc Cutter Bit at the Nevada Test Site.** (Fenix and Scisson, Inc., Las Vegas, NV (USA)). 1987. Contract AC08-84NV10322. 23p. NTIS, PC A02. File Number DE87009332.

From Institute of Shaft Drilling Technology annual technical conference; Las Vegas, NV, USA (13 May 1987).

This paper addresses the first runs of a 96-inch diameter Robbins Disc Cutter Bit using dual string reverse circulation in the drilling of large diameter emplacement holes at the Nevada Test Site in 1986. As a result of knowledge gained during those initial runs, combined with years of conventional large-diameter bit experience, a proposed new Combination Kerf-Disc Cutter Bit design is presented. At the present time, it is believed that the Disc Cutter Bit, properly designed and properly used, has the potential to reduce drilling costs through a combination of increasing ROP's, longer time on bottom over conventional bits, and reduced redressing costs.

37456 (DOE/METC—86/6069, pp 270-271) **Reduced girth seam weldments for heavy-walled vessels and burst tubes.** Horacek, D.R.; Peters, S.W. (CBI Na-Con, Inc., Oak Brook, IL). Jan 1987. NTIS, PC A13/MF A01. File Number DE86006596. (CONF-860961—). Contract AC21-86MC22068.

From Instrumentation, components and materials contractors' meeting; Morgantown, WV, USA (16 Sep 1986).

The project is to develop a design procedure that will justify a reduction in the girth seam weldments to approximately 2/3's of the nominal vessel wall thickness. This reduction in welding thickness will greatly reduce the welding costs and schedule for site-erected pressure vessels, thereby reducing the overall cost of heavy-wall vessels. Preliminary estimates indicate a cost savings of 10-15% for a given vessel. The concept of designing a concept of designing a cylindrical pressure vessel with local areas of reduced thickness is based on the fact that the axial stress is only half of circumferential stress. Therefore, the thickness of the vessel is determined by circumferential stress as related to allowable general membrane stress from the governing Code. For a discontinuity in the vessel such as a cone-to-cylinder junction or a head-to-cylinder junction, the Code allow a 1.5 factor increase in the local membrane stress. The local reduction in thickness can be treated as a similar discontinuity and therefore the allowable stress is justified because the material on either side of the thin area will tend to carry some of the load from the thin area due to compatibility. CBI fabricated and tested 16-inch diameter heads that were called from actual full-pressure steel nuclear containment vessels. The purposes of the tests were to determine the buckling pressure and the failure pressure for the heads. CBI has also conducted several series of tests for API to determine the behavior of stiffened cylinders. Ring and stringer stiffened cylinders were subjected to various combinations of axial load and external pressure to determine failure modes. The research was used to develop design rules for tubular members in offshore structures.

37457 **(DP-MS—87-62) Protective clothing use at the Savannah River Plant Nuclear Facility.** Cabbil, C.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 21p. (CONF-8705143—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011243.

From 1. annual conference on protective clothing; Clemson, SC, USA (29 May 1987).

The mission of the Savannah River Plant in producing nuclear materials does pose some unique protective clothing and

equipment requirements not usually seen in the general industry. In addition to protection from the chemicals and physical agents encountered, radioactive hazards must also be managed. This paper describes the protective clothing and respiratory protection used at SRP, and focuses particularly on the development of a new plastic suit. 5 refs., 7 figs., 3 tabs.

37458 **(IS-T—1276) Annihilation of vortex-antivortex pairs in a superconducting shield.** Fang, Ming Ming. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010921.

A new type of magnetic shielding device has been constructed for use in superconducting microelectronic applications where low ambient magnetic field is desirable. The shield was a specially designed superconducting thin film in the shape of a long cylindrical tube with a low pinning material in the central region and high flux pinning regions at the end. It was shown that magnetic flux perpendicular to the axis of a cylinder could be swept out of the interior of the shield by moving vortex-antivortex pairs to one side of the shield where they annihilate. The flux sweeping properties of the shield were found to work well in a small temperature window close to the transition temperature where the critical current for depinning vortices was less than the critical current for the formation of hot spots. Once the vortices are swept out, the shield can be cooled to enhance the Meissner shielding effects against other stray fields. In the course of designing and testing the shield, a systematic study of flux pinning was made for the low magnetic field regime between 1 mOe and 30 Oe.

37459 **(NCRP—88) Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 30 Dec 1986. 89p. National Council on Radiation Protection and Measurements, 7910 Woodmont Ave., Bethesda, MD 20814. File Number TI87900829.

In facilities where radioactive materials are handled, or where radiation-producing equipment is used, the building, the equipment, and the associated safety procedures should be designed and developed together to provide a safe work environment. The specific combination of requirements for a given facility is defined by the operational radiation safety program. It should be emphasized that this report describes a range of alarm and access control systems that can provide an acceptable level of safety at many types of facilities. Depending on circumstances, the solutions offered may not be appropriate for certain facilities because they are to restrictive, not restrictive enough, or do not cover all circumstances. The document is offered as a starting point providing ideas that professional health physicists can adapt to meet the needs of a particular situation. Under no circumstances should this report be interpreted in "cookbook" fashion, with literal adherence to every recommendation demanded, nor should it be expected to provide adequate protection in every case without consideration of local conditions.

37460 **(SAND—86-2447C) An experimental and analytical evaluation of a Type B radioactive transport container.** Moya, J.L.; Akau, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 19p. (CONF-870816—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006657.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

A thermal test of the Beneficial Uses Shipping System (BUSS) cask containing irradiation source capsules was conducted to verify a two-dimensional axisymmetric thermal model developed for the Safety Analysis Report. The BUSS cask is a Type B package developed to transport irradiation source capsules of cesium chloride or strontium fluoride to commercially licensed food and pharmaceutical irradiating facilities. The uniqueness of this test is that it was performed on an internally instrumented, full-scale cask with actual radioactive capsules. This results in more realistic system temperatures than those obtained if heaters were used to simulate the large gamma source. In addition, the thermal test provides benchmark data for other thermal codes.

37461 **(SAND—86-2470) Robotic handling of spent fuel shipping casks: Preliminary assessment of cask design impacts and technology development needs.** Strip, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012504.

Specific design guidelines will be required in order to facilitate robotic handling of spent fuel shipping casks. In order to develop these guidelines it is necessary to evaluate where robotic handling can contribute most in achieving system design objectives, such as reducing occupational radiation exposure and increasing system throughput. Priorities are developed for determining which robotic handling tasks offer the most potential for contributing to system objectives. An additional set of priorities is developed on the time by which the results of feasibility demonstrations and other simpler assessments are needed in order to contribute to the cask design process. The priorities are used to identify which robotic handling tasks need to be assessed in detail and when these results are needed in the cask design cycle. An outline of the type of information that needs to be developed in the feasibility demonstrations is provided.

37462 **(SAND—87-0094C) Thermal measurements in large pool fires.** Gregory, J.J.; Keltner, N.R.; Mata, R. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 34p. (CONF-870816—8). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005870.

From Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference; Pittsburgh, PA, USA (9 Aug 1987).

During the summer of 1983, a series of pool fire tests was conducted in which the test item was a 1.4 m diameter, 6.4 m long, mild steel calorimeter with a mass of approximately 10,000 kg. Purpose of these tests was to study the thermal response of a large test item in a specified fire configuration, to define thermal boundary conditions, and to assess the repeatability of the fire environment. The calorimeter was used to simulate a nuclear waste transportation cask in both a geometric and thermal sense.

37463 **(SAND—87-0273C) Insertions using geometric analysis and hybrid force-position control on a PUMA 560 with VAL II.** Strip, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 11p. (CONF-870734—1). NTIS, PC A02. File Number DE87005875.

From American Association for Artificial Intelligence meeting; Seattle, WA, USA (13 Jul 1987).

Automatic programming of insertions is an essential step in achieving a truly flexible manufacturing environment. Techniques are presented based on active compliance implemented with hybrid force-position control capable of inserting a wide variety of shaped pegs. These techniques provide a significant step towards an automatically programmed flexible manufacturing environment.

37464 **(SAND—87-0641C) Heat transfer to large objects in large pool fires.** Bainbridge, B.L.; Keltner, N.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 32p. (CONF-870895—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011317.

From Major hazards in the transport and storage of pressure liquefied gases conference; Fredericton, Canada (10 Aug 1987).

Large pool fires are used to expose radioactive material shipping containers to levels of temperature and heat flux required by regulatory agencies. Due to the nature of outdoor pool fires, a large effort has gone into characterizing the temporal and spatial variability of the thermal environment. Three tests were performed in the summer of 1983 involving a 9.1 by 18.3 meter pool fire fueled with JP-4 aviation fuel. A calorimeter 1.4 m in diameter by 6.1 m long was used to examine the thermal input to a relatively large, massive object. An examination of temperature and heat flux data emphasizes the effect of even low wind conditions on the overall structure of the fire. In an attempt to examine the thermal environment in the absence of any disturbances, a 'conditioning signal' was used to extract data during periods of low wind. Heat flux and temperature data obtained from the large pool fire tests is

presented and the variation over the surface of the large calorimeter is examined. The application of a conditioning signal is used to reduce the wind induced variance in the heat flux data.

37465 **(SAND—87-1702C) Base technology development enhances state-of-the-art in meeting performance requirements.** Freedman, J.M.; Allen, G.C. Jr.; Luna, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870713—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012363.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Sandia National Laboratories (SNL) has responsibility to the United States Department of Energy (DOE) for baseline technology to support the design of radioactive material transportation packages. To fulfill this responsibility, SNL works with industry, government agencies, and national laboratories to identify and develop state-of-the-art technology required to design and test safe, cost-effective radioactive materials packages. Principal elements of the base technology program include: (1) analysis techniques; (2) testing; (3) subsystem and component development; (4) packaging systems development support; and (5) technical support for policy development. These program elements support a systems approach for meeting performance requirements and assure that there is a sound underlying technical basis for both transportation packaging design and associated policy decisions. Highlights from the base technology program included in this paper are testing, design and analysis methods, advanced materials, risk assessment and logistics models, and transportation package support.

37466 **(UCID—21073) Numerical assessment of high frequency (HF) antennas for shipboard use.** Latorre, V.R.; Breakall, J.K. (Lawrence Livermore National Lab., CA (USA)). 23 Jan 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010849.

We assess the HF antennas on a preliminary numerical and size basis, and present the results in this report. It is important to note that the data were compiled from information received in response to our survey (see our first report), and consequently, these data are not always complete. In addition, not all of the commercial firms surveyed use the same quantities to describe their antennas. Because of this, we have provided a section on terminology in which the parameters used to describe the different antennas are defined. Many of these terms were discussed in the previous Interim Report (October 20, 1986) but are repeated here for completeness. A table of the applicable, available antennas is also presented in this report. Numerical values for the different antenna parameters are included wherever possible. From an examination of the tables, those HF antennas showing the most promise for shipboard use are selected for future testing and/or development, and are arranged in descending order of priority.

37467 **(UCID—21083) An evaluation of three temperature controllers for a +-0.002°C application.** Ornellas, D. (Lawrence Livermore National Lab., CA (USA)). 8 Apr 1987. Contract W-7405-ENG-48. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010620.

Three temperature controllers were evaluated in a calorimeter bath in which temperature control of +-0.002°C or better for a three hour period is required. The controllers were Thermotrol, Micristar and Bayley. The Thermotrol, and the Bayley both met this requirement with the Thermotrol slightly better. The Thermotrol has been used in this application for 26 years. The Micristar did not meet this requirement by an order of magnitude.

37468 **(UCRL—96021) Performance analysis of the two-stage light gas gun.** Glenn, L.A. (Lawrence Livermore National Lab., CA (USA)). 5 May 1987. Contract W-7405-ENG-48. 20p. (CONF-870753—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009745.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A 1 1/2D Arbitrary Lagrange Eulerian (ALE) code was developed to analyse the dynamics of the two-stage light gas gun. Comparison of the resultant calculations with measured projectile velocities yielded very good agreement over a wide range of operating conditions and for two different test facilities. A parametric study was then performed to assess the optimum performance space. Design parameters included pump- and launch-tube geometry, transition section shape and length, piston mass and velocity, burst diaphragm release pressure, and initial gas pressure and temperature. For conventional designs, it was found that the maximum projectile velocity is limited primarily by the maximum pressure that can be tolerated in the transition section connecting pump- to launch-tube. Velocities in excess of 11 km/s appear feasible, but this requires the capability of dealing with peak pressures up to 1.5 GPa.

37469 **(UCRL—96629) A design procedure to tune the dynamic stiffness of an externally pressurized gas bearing.** Roblee, J.W. (Lawrence Livermore National Lab., CA (USA)). 14 Apr 1987. Contract W-7405-ENG-48. 13p. (CONF-8703127—1). NTIS, PC A02. File Number DE87009747.

From 4. international technical symposium on optical and electro-optical applied science and engineering; Hague, Netherlands (30 Mar 1987).

A design procedure for flat, circular thrust bearings is presented here. The procedure is based upon a new dynamic model of the bearing and the principle of tuning the bearing's dynamic stiffness to optimize the dynamic performance of the overall, machine-bearing system. The design procedure is iterative so as to satisfy a number of different design constraints and is illustrated in an example problem.

37470 **Amplitude calculation near a period-doubling bifurcation: An example.** Wiesenfeld, K.; Pedersen, N.F. (Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] A: General Physics;* **36**: No. 3, 1440-1444(1 Aug 1987). Contract AC02-76CH00016.

For the rf-driven Josephson junction, the dynamical behavior is studied near a period-doubling transition. The center-manifold theorem simplifies the problem and enables us to study only a first-order system, the parameters of which are expressed in terms of the Josephson-junction parameters.

37471 **Support assembly having three dimension position adjustment capabilities.** Cutburth, R.W.; House, F.A. (to Dept. of Energy, Washington, DC). US Patent 4,667,922. 26 May 1987. Filed date 8 Nov 1985. vp.

An assembly is described for supporting an apparatus to and against a planar surface. The assembly includes an arrangement for adjusting the position of a segment of the apparatus in the x-, y-, and z-directions with respect to the planar surface, where the x-direction and the y-direction are both parallel with the planar surface and perpendicular to one another and where the z-direction is perpendicular to the planar surface and the x-and y-directions. The arrangement comprises: first means including a support block defining a groove which extends in the x-direction and which has a V-shaped cross section interlocked with the apparatus segment for movement with the latter in the x- and y-directions but not the z-direction relative to the planar surface; second means including a sphere extending into the groove of the support block.

## 4203 Lasers

37472 **(AD-A—179399/1/XAB) Measurements of amplification and phase shift (wave refractive index) in a free-electron laser.** Fajans, J.; Bekefi, G. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Oct 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Physics of Fluids, Vol. 29, No. 10, 3461-3469(Oct 1986).

Measurements of the amplification and phase shifts (wave refractive index) in a free-electron laser (FEL) are reported. The studies were carried out at microwave frequencies (7-16 GHz) in a free-electron laser operating in the collective (Raman) regime, using a mildly relativistic electron beam with energy of about 160 keV, and current of about 5A. The observations are found to be in excel-

lent agreement with theoretical predictions based on the full three-dimensional FEL dispersion relation.

37473 **(AD-A—179616/8/XAB) Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986.** Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). 31 Jan 1987. 65p. NTIS, PC A04/MF A01.

This project concerns the demonstration of the feasibility of the tuning and perhaps even stimulation of nuclear radiation. Theory has indicated that anti-Stokes Raman upconversion of intense but conventional long-wavelength sources of radiation produced by scattering from isomeric states of nuclear excitation could lead to significant sources of tunable gamma-radiation characterized by the natural Moessbauer widths of the lines. This would result in lines with sub-Angstrom wavelengths and widths of a few MHz. Whether or not these processes can reach threshold depends upon the resolution of basic issues lying in an interdisciplinary region between quantum electronics and nuclear physics that have not been previously addressed. It was the purpose of this work to study these issues experimentally.

37474 **(CONF-870401—3-Abst.) Promethium ($Pm^{3+}$) solid state laser.** Shinn, M.D.; Krupke, W.F.; Kirchoff, T.A.; Finch, C.B.; Boatner, L.A. (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011113.

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

The achievement of stimulated emission from the trivalent promethium ion is reported. (DLC)

37475 **(ENEA-RT-TIB—86-37) Research and development activities on the Free Electron Laser (FEL) at the ENEA Frascati Energy Researches Center.** Marino, M.; Renieri, A. (ENEA, Rome (Italy)). Mar 1987. 27p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752633.

In this article research and development activities on the free electron laser (FEL) at the ENEA Frascati Center are described. In particular the last experimental results obtained with the infrared FEL source are reported.

37476 **(ENEA-RT-TIB—86-38) Instability in a multimode Free Electron Laser: effects of electron energy drift.** Dattoli, G.; Renieri, A.; Gallardo, J.C.; Elias, L. (ENEA, Rome (Italy)). Feb 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752634.

We discuss a phenomenological one dimensional, self-consistent, multimode (longitudinal) theory for a Free Electron Laser oscillator. A strong fundamental mode and weak side-band mode is followed through many passes in the optical cavitys the energy of the electron beam decreases monotonously. The time evolution of the laser power exhibits oscillations produced by the sequential growth to saturation and subsequent decay of longitudinal modes evenly distributed in frequency.

37477 **(ENEA-RT-TIB—86-42) Analytical treatment of Free Electron Laser in the long pulse limit.** Dattoli, G.; Renieri, A.; Torre, A.; Gallardo, J.C. (ENEA, Rome (Italy)). Feb 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752637.

We discuss a method to obtain analytical solutions of the evolution equation of the optical signal in longe pulse Free Electron Laser oscillators in the low gain and small signal regime. Supermodes are identified with the eigenstates, harmonic oscillator orthonormal functions, of a non-hermitian Hamiltonian. Inhomogeneous broadening effect due to energy spread and emittance are included. The time-space characteristics of the laser field are obtained with a significant reduction in the computer time.

37478 **(ENEA-RT-TIB—86-43) Self-consistent classical analysis of a start-up in a Free Electron Laser.** Dattoli, G.; Caloi, R.; Gallardo, J.C.; Torre, A. (ENEA, Rome (Italy)). Mar 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752636.

We describe a multimode self-consistent theory of a short pulse Free Electron Laser oscillator. We write the rate equation for the optical field which contain s a phase lock coupling between longitudinal modes. We present plots of the laser field spectrum evolution for different values of the electron micro-bunch length and cavity detuning parameter.

37479 **(ENEA-RT-TIB—86-44) Spontaneous emission in Cerenkov FEL devices: a preliminary theoretical and experimental analysis.** Ciocci, F.; Dattoli, G.; Torre, A.; Walsh, J.E.; Doria, A.; Schettini, G. (ENEA, Rome (Italy)). Feb 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752638.

The main features of the spectral characteristics of the spontaneously emitted Cerenkov light in circular and rectangular waveguides filled with dielectric are discussed. The characteristics of the radiation emitted by an electron beam moving near and parallel to the surface of a dielectric slab are also analysed. Finally, the relevance of these results to a possible FEL-Cerenkov operation is briefly discussed.

37480 **(ENEA-RT-TIB—86-53) Spontaneous emission in a double dielectric slab for Cerenkov-FEL operation.** Ciocci, F.; Dattoli, G.; Gallerano, G.P.; Torre, A.; Walsh, J.E.; Doria, A.; Schettini, G. (ENEA, Rome (Italy)). Feb 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752635.

The double slab waveguide configuration for a Cerenkov Free Elecron Laser (C-FEL) is discussed, it is shown that it may allow higher emission brightness with respect to the single slab configuration.

37481 **(ENEA-RT-TIB—86-59) Materials depositions produced by laser radiation.** Borsella, E.; Fantoni, R. (ENEA, Rome (Italy)). Feb 1987. 35p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752639.

The process of molecular laser induced dissociation followed by thin film or powder deposition are reviewed in the present paper. Both the mechanisms of pyrolysis and photolysis are considered. These laser methods are found to be especially suitable for some high technology and industrial applications.

37482 **(ENEA-RT-TIB—86-61) Increase of current from 35 to 120 mA of the 20 MeV Frascati microtron.** Bizzarri, U.; Messina, G.; Mola, A.; Picardi, L.; Vignati, A. (ENEA, Rome (Italy)). Feb 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752632.

This paper deals with the improvements applied to the Frascati microtron with the aim of obtaining an increase in the extracted current. The achievement of beam of 120 mA permitted the successful outcome of the 1985 FEL experiments.

37483 **(LA-UR—87-1535) Cherenkov and transition radiation diagnostics for high energy free-electron lasers.** Lumpkin, A.H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870622—6). NTIS, PC A02. File Number DE87010106.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

Electron Beam diagnostics based on imaging techniques using Cherenkov conversion screens and intensified video cameras should be adaptable to the developing high-energy free-electron lasers (FEL) driven by radio frequency powered linear accelerators. The high beam energies (60-150 MeV) and the peak currents (100s of amps) anticipated should also make optical transition radiation intensities sufficient for these techniques. The distinctive features of the two light generation mechanisms will be summarized and a few diagnostic examples will be cited.

37484 **(LA-UR—87-1714) Optical analysis of high power free electron laser resonators.** Knapp, C.E.; Viswanathan, V.K.; Appert, Q.D.; Bender, S.C.; McVey, B.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870622—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010126.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

The first part of this paper briefly describes the optics code used at Los Alamos National Laboratory to do optical analyses of various components of a free electron laser. The body of the paper then discusses the recent results in modeling low frequency gratings and ripple on the surfaces of liquid-cooled mirrors. The ripple is caused by structural/thermal effects in the mirror surface due to heating by optical absorption in high power resonators. Of interest is how much ripple can be permitted before diffractive losses or optical mode distortions become unacceptable. Preliminary work is presented involving classical diffraction problems to support the ripple study. The limitations of the techniques are discussed and the results are compared to experimental results where available.

37485 **(PB—87-173613/XAB) Growth of garnet crystals for laser applications. Final report, 1 February-31 July 1984.** Khattak, C.P. (Crystal Systems, Inc., Salem, MA (USA)). Aug 1984. 33p. (CSI—84-105). NTIS, PC A03/MF A01.

The objective of the Phase I effort was to establish feasibility of growth of Gd3Ga5O12(GGG) crystals as a precursor to growth of other garnet crystals, e.g. Gd35c2Ga3O12 (GSGG), for laser applications. Experimental work showed that $Ga_2O_3$ has a high vapor pressure and, therefore, it results in decomposition of GGG prior to meltdown. Introduction of oxygen into the furnace chamber to prevent decomposition was not feasible with existing graphite resistance-heated HEM furnaces. An alternative material in the Al-garnet family, Gd3Sc2Al3O12 (GSAG), was chosen. The higher stability of the melt suggests that low intrinsic defects containing larger crystals of GSAG can be grown as compared to GSGG. This new class of garnet-structured crystals offers potential for high-power, tunable, solid-state laser materials.

37486 **(UCID—20682) Multimegajoule laser design.** Manes, K.R.; Ozarski, R.G.; Hagen, W.F.; Holzrichtr, J.F. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011004.

New technologies make multimegajoule glass lasers economically feasible. We have devised new laser architectures using harmonic switchout, target-plane holographic injection, phase conjugation, continuous apodization, and higher amplifier efficiencies. Our plan for building a multimegajoule laser for a recurring cost under $300 million relies on the following manufacturing economies of scale: high-volume glass production, rapid harmonic-crystal growth, capacitor sizing and packing to increase energy capacity, and part standardization.

37487 **(UCRL—93796) High average power solid state laser developments at the Lawrence Livermore National Laboratory.** Summers, M.A.; Trenholme, J.B.; Gagnon, W.L.; Gelinas, R.J.; Stokowski, S.E.; Marion, J.E.; Julien, H.L.; Blink, J.A.; Bender, D.A.; Riley, M.O. (Lawrence Livermore National Lab., CA (USA)). 20 Dec 1985. Contract W-7405-ENG-48. 19p. (CONF-860117—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008740.

From Los Angeles symposium and exhibition on optical and electro-optical engineering; Los Angeles, CA, USA (19 Jan 1986).

The purpose of the High Average Power Solid State Laser Program at the Lawrence Livermore National Laboratory is to develop new technologies for significantly increasing the average power capability, beam quality, efficiency, and wavelength agility of solid state lasers. The program emphasis is to advance the state-of-the-art and is not directed toward a specific application.

37488 **(UCRL—96579) X-ray laser world wide progress.** Matthews, D.L. (Lawrence Livermore National Lab., CA (USA)). 12 May 1987. Contract W-7405-ENG-48. 22p. (CONF-8705118—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010337.

From International school of quantum electronics; Erice, Italy (11 May 1987).

This summary describes the x-ray laser, discusses its status of development world wide, and speculates on its future. At this time, vigorous research in the USA, France and Great Britain has not only demonstrated amplification of soft x-rays, but has pushed the observed lasing wavelengths from ~28 nm to 6.1 nm. Knowledge obtained from this work has led to the design of new schemes likely to reach even shorter wavelengths, perhaps less than the carbon K absorption edge at 4.37 nm. Researchers have also obtained saturated output at a few megawatts of power with a divergence (geometric) of a few mrad at ~20 nm. If research continues at this pace, the x-ray laser will be available in a few more years with GW power levels, sub 4.4 nm wavelengths and fully-coherent beams.

37489 **Electro-optical modulator for an electro-optically modulated laser.** Plourde, B.E.; Mack, M.E. (to Secretary of the Navy, Washington, DC). US Patent 4,669,085. 26 May 1987. Filed date 6 Mar 1981. vp.

This patent describes an electro-optically modulated laser, comprising a lasing medium, a pair of spaced etalons and a birefringent electro-optical device arranged in an optical cavity. The improved electro-optical modulator includes: a hydrogen thyratron having an "ON" and an "OFF" state; means for selectively pressurizing the hydrogen thyratron; means, response to the "OFF" state of the hydrogen thyratron, for impressing a first preselected voltage across the birefringent electro-optical device; means, responsive to the "ON" state of the hydrogen thyratron, for impressing a second preselected voltage across the birefringent electro-optical device in a time that corresponds to the laser buildup interval; and means for repetitively driving the hydrogen thyratron into the "ON" and the "OFF" states.

37490 **Minimum inductance laser head for pulsed transverse discharges without wall tracking.** Shipman, J.D. Jr.; Wexler, B.L. (to Secretary of the Navy, Washington, DC). US Patent 4,665,526. 12 May 1987. Filed date 15 May 1986. vp.

This patent describes a transverse discharge device structure for use in a laser, comprising: dielectric wall material forming a housing about a discharge region; two discharge electrodes disposed in spaced relation within the region, the region supporting an electric field between the electrodes when they are energized by a potential difference applied to the electrodes; and means for imparting a particular configuration to the electric field characterized by a pattern of equipotential lines essentially free of field enhancements and field directions that would accelerate charged particles from the discharge region toward the dielectric wall material. The means comprise two conducting vanes situated outside the housing to one side of the discharge electrodes.

37491 **(N—87-20802) Kinetic model for the vibrational energy exchange in flowing molecular gas mixtures. Ph.D. Thesis.** Offenhaeuser, F. (National Aeronautics and Space Administration, Washington, DC (USA)). Mar 1987. Transl. into ENGLISH of Kinestisches Modell fuer den Schwingungsenergieaustausch in Stroemenden Moleskuelgasgemischen Stuttgart, West Germany, 13 Feb. 1985 p 1-101. (NASA-TM—88500; NAS—1.15:88500). 97p. NTIS, PC A05/MF A01.

The present study is concerned with the development of a computational model for the description of the vibrational energy exchange in flowing gas mixtures, taking into account a given number of energy levels for each vibrational degree of freedom. It is possible to select an arbitrary number of energy levels. The presented model uses values in the range from 10 to approximately 40. The distribution of energy with respect to these levels can differ from the equilibrium distribution. The kinetic model developed can be employed for arbitrary gaseous mixtures with an arbitrary number of vibrational degrees of freedom for each type of gas. The application of the model to $CO_2$-$H_2O$-$N_2$-$O_2$-He mixtures is discussed. The obtained relations can be utilized in a study of the suitability of radiation-related transitional processes, involving the $CO_2$ molecule, for laser applications. It is found that the computational results provided by the model agree very well with experimental

data obtained for a $CO_2$ laser. Possibilities for the activation of a 16-micron and 14-micron laser are considered.

37492 **Free-electron laser success explained.** Robinson, A.L. *Science (Washington, D.C.);* 235: 27-29(2 Jan 1987).

The author summarizes results of a breakthrough at Lawrence Livermore National Lab. (LLNL) over two years ago, but only recently reported because of security classification. Essentially, a special magnet called a tapered undulator was used to effect the conversion of 40% of the energy of the electron beam of an LLNL accelerator into microwave laser radiation (NOTE: tapering is maintaining the necessary resonance condition by progressively decreasing the dipole period or the magnetic flux along the undulator). This establishes the free-electron laser (FEL) as a leading candidate for the directed-energy alternatives in the Strategic Defense Initiative (SDI) program. The Army's Strategic Defense Command, which is managing the SDI FEL program, is interested in near-infrared wavelengths near 1 μm and intends to build a facility for such research at its White Sands Missile Range in New Mexico. The author describes the basics of the LLNL experiment and some of the closely related work of Los Alamos Scientific Lab. and a Boeing Aerospace - Spectra Technology collaboration, emphasizing the problems in going to the visible or near-infrared wavelengths. The near-term future activities of each of these organizations are described briefly. 2 references.

## 4204 Heat Transfer And Fluid Flow

*REFER ALSO TO CITATION(S) 36426, 36708, 36758, 36852, 37442, 38099*

37493 **(DOE/PC/90961—T3) Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period March 1, 1987 to May 31, 1987.** Kadambi, J.R. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Mechanical and Aerospace Engineering). 1987. Contract FG22-86PC90961. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011264.

The combination selected for equivalent index of refraction in solid particle and liquid was silica gel and sodium iodide solution. The refractive index of silica gel is 1.443 at 20°C. As we can observe from Figure 1, a very good match in refractive indexes can be achieved by using a 50% NaI solution in water at nearly 25°C. The density ratio between hydrated silica gel and sodium iodide solution is nearly 1.16. Samples of silica gel-sodium iodide solution slurries have been kept over a time period of a few weeks to ensure that NaI solution and silica gel do not react. Effect of light on sodium iodide results in release of a little bit of iodine. This can be suppressed by the addition of very small amounts of sodium hydroxide or sodium thiosulfate. We have, therefore, selected silica gel as the solid and sodium iodide solution in water as the liquid for this project. For the successful design of an experimental test loop, it is important to have some information regarding pressure losses due to friction in this solid-liquid flow consisting of silica gel and sodium iodide solution. We have now set up a simple test to obtain friction losses for silica gel (50 micron size particles) with concentrations varying from 0 to nearly 50%. These tests will be performed for at least two different diameter pipes. The tests are being conducted now.

37494 **(N—87-20501) Prediction of recirculation zones in isothermal coaxial jet flows relevant to combustors.** Nallasamy, M. (Universities Space Research Association, Boulder, CO (USA)). Apr 1987. 23p. (NASA-CR—4064; NAS—1.26:4064). NTIS, PC A02/MF A01.

The characteristics of the recirculation zones in confined coaxial turbulent jets are investigated numerically employing the kappa - epsilon turbulence model. The geometrical arrangement corresponds to the experimental study of Owen (AIAA J. 1976) and the investigation is undertaken to provide information for isothermal flow relevant to combustor flows. For the first time, the shape, size, and location of the recirculation zones for the above experimental configuration are correctly predicted. The processes leading to the observed results are explained. Detailed comparisons of the prediction with measurements are made. It is shown that the recirculation zones are very sensitive to the central jet exit configuration and the velocity ratio of the jets.

37495 **(N—87-20968) Algorithm implementation on the Navier-Stokes computer.** Krist, S.E.; Zang, T.A. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Mar 1987. 76p. (NASA-TM—89119; NAS—1.15:89119). NTIS, PC A05/MF A01.

The Navier-Stokes Computer is a multi-purpose parallel-processing supercomputer which is currently under development at Princeton University. It consists of multiple local memory parallel processors, called Nodes, which are interconnected in a hypercube network. Details of the procedures involved in implementing an algorithm on the Navier-Stokes computer are presented. The particular finite difference algorithm considered in this analysis was developed for simulation of laminar-turbulent transition in wall bounded shear flows. Projected timing results for implementing this algorithm indicate that operation rates in excess of 42 GFLOPS are feasible on a 128 Node machine.

37496 **(N—87-21257) Flowfield measurements in a separated and reattached flat plate turbulent boundary layer. Final report.** Patrick, W.P. (United Technologies Research Center, East Hartford, CT (USA)). Mar 1987. 245p. (NASA-CR—4052; E—3254; NAS—1.26:4052). NTIS, PC A11/MF A01.

The separation and reattachment of a large-scale, two-dimensional turbulent boundary layer at low subsonic speed on a flat plate has been studied experimentally. The separation bubble was 55 cm long and had a maximum bubble thickness, measured to the height of the mean dividing streamline, of 17 cm, which was twice the thickness of the inlet boundary layer. A combination of laser velocimetry, hot-wire anemometry, pneumatic probing techniques, and flow visualization were used as diagnostics. Principal findings were that an outer inviscid rotational flow was defined which essentially convected over the blockage associated with the inner, viscously dominated bubble recirculation region. A strong backflow region in which the flow moved upstream 100 percent of the time was measured near the test surface over the central 35 percent of the bubble. A laminar backflow boundary layer having pseudo-turbulent characteristics including a log-linear velocity profile was generated under the highly turbulent backflow. Velocity profile shapes in the reversed flow region matched a previously developed universal backflow profile at the upstream edge of the separation region but not in the steady backflow region downstream. A smoke flow visualization movie and hot-film measurements revealed low frequency nonperiodic flapping at reattachment. However, forward flow fraction data at reattachment and mean velocity profiles in the redeveloping boundary layer downstream of reattachment correlated with backward-facing step data when the axial dimension was scaled by the distance from the maximum bubble thickness to reattachment.

37497 **(NP—7770113) Heating exchanger networks, an exergo-economic study.** Hesselmann, K. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 21 Aug 1985. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770113.

The author discusses economic aspects of heat exchanger systems design, with particular regard to the interdependence between energy costs and capital costs. He first presents fundamental concepts of heat exchanger networks, model assumptions and goals. Examples from relevant publications are discussed, and solution algorithms are gone into. This is followed by an exergo-economic analysis and an energetic optimisation of the outer subsystem. Particular interest is taken in the optimum structuring of adiabatic heat exchanger networks in consideration of the heuristic rules. The economic optimisation of the outer subsystem is discussed, and relevant publications are listed. (HAG).

37498 **(NP—7770121) Numerical calculation of turbulent flow around a cubic element.** Baetke, F. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 28 Feb 1986. 245p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87770121.

Three-dimensional flow around angular bodies is characterized by complex recirculation zones and can be calculated only by a numerical solution of the Navier-Stokes equation. Discretisation

methods and methods for modelling turbulence phenomena are compared. Using finite differences and statistical turbulence models, a solution algorithm is established which takes account in a simple manner also of complex boundary geometries and permits a free choice of approximation methods for the observed volume flows. The algorithm can be vectorized, thus making optimum use of the capacities of modern computer architectures. The efficiency of the algorithm is proved for the turbulent flow field near a cube mounted on a bottom plate.

37499 **(PB—87-173936/XAB) Gas-liquid pipe flow with drag reducers. Doctoral thesis.** Hamersma, P.J. (Amsterdam Univ. (Netherlands)). 1983. 193p. (In Dutch). NTIS, PC PC E07/MF E01.

In the chemical industry gas-liquid pipe flow is often applied in all sorts of equipment, e.g. heat exchangers, reboilers, condensers, spray and bubble columns, pipelines etc. In this thesis, special attention is paid to the frictional pressure losses in co-current gas-liquid flow in straight and in coiled tubes with a small volume fraction of liquid in the cross section of the tube (O < E/sub L/ < 0.04). This kind of two-phase flow can appear when natural gas is transported through a pipeline system. It is well known that traces of liquid are added to natural gas in these systems to prevent formation of gas hydrates. Further, it can be stated that traces of liquid (condensate) can occur if the pressure of the gas is decreased in passing through a pipeline.

37500 **(PB—87-182218/XAB) Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985.** Stillwagon, T.; Kotchick, D.; Coombs, M. (AiResearch Mfg. Co., Torrance, CA (USA)). Mar 1987. 136p. (REPT—86-30019). NTIS, PC A07/MF A01.

This report describes part of a comprehensive research effort performed to verify the performance characteristics of several ceramic materials for use in industrial-size tubular flue-gas recuperators. Results of the baseline study were used to qualify three materials for further testing of long-term exposure to industrial furnace flue gases. Flexural strengths, using a C-ring specimen geometry, were measured on unoxidized and preoxidized samples at room temperature and on preoxidized samples at three elevated temperatures. Weibull plots were derived from the strength data for analysis. Failure-origin analysis was conducted on the fractured C-ring specimens to determine trends in their location or type. Microstructure characterization was conducted on all six candidate silicon-carbide materials.

37501 **(TKK-KO/ET—21) Determination of heat transfer in pool boiling and forced convective boiling.** Jaervinen, E.; Fagerholm, N.-E. (Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering). 1986. 115p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752377.

The scope of this work was present different pool boiling and flow boiling correlations and compare these by calculation. Calculations were done by water and refrigerant R12. Short notes has done concerning different theoretical boiling models. Some basic defination and terminology of two phase boiling phenomen has shown and 6 pool boiling correlation and 20 flow boiling correlation are presented. In the results of calculations in high pressures flow boiling correlations are compared with measurement results collected from litterature. In pool boiling calculation results of three latest correlations, Stephan-Abdelsalam (1978), VDI (1984) and Cooper (1984), mean absolute deviation was within limits 30%-40%. In flow boiling calculation results of four general correlation, Chen (1966), Shah (1976), VDI (1984) and Gungor (1986), mean absolute deviation was within limits 20%-30%. Correlations predicting only concective flow boiling gave 1-1.5 times higher boiling heat transfer coefficients than general correlations in convective boiling. Calculations were done by water and refrigerant R12 by pressure p=0.135. In similar case, convetive flow boiling correlations, which were modified to tackle both nucleate boiling and convection boiling sections in flow boiling, gave 1-2 times higher boiling heat transfer coefficient compared with values predicted by general correlations. 43 figs.

37502 **(UCRL—96443) Adaptive methods for high Mach number reacting flow.** Bell, J.B.; Colella, P.; Trangenstein, J.A.; Welcome, M. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 29p. (CONF-8706104—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008846.

From 8. American Institute of Aeronautics and Astronautics computational fluid dynamics conference; Honolulu, HI, USA (9 Jun 1987).

This paper describes some adaptive techniques suitable for modeling high Mach number reacting flows. Two basic types of methods are considered: adaptive mesh techniques and front tracking. Numerical results are described using one of these methods, local mesh refinement, for a simple model for planar detonation. The computational results show the formation of Mach triple points in the detonation fronts and provide an initial step toward understanding the factors influencing the spacing. 10 refs., 30 figs.

37503 **Conduction of heat from a planar wall with uniform surface temperature to a monodispersed suspension of spheres.** Chang, E.Y.; Acrivos, A. (Department of Chemical Engineering, Stanford University, Stanford, California 94305-5025). *Journal of Applied Physics;* **62**: No. 3, 771-776(1 Aug 1987).

We consider the problem of heat conduction near an isothermal wall in contact with a composite consisting of a matrix containing a random dispersion of spheres having a different thermal conductivity than the matrix. Far away from the wall, i.e., on the macroscopic length scale, the average bulk temperature field is composed of a uniform gradient term plus a constant offset. If the temperature of the wall is set equal to zero, this offset temperature, which would vanish if the composite were replaced everywhere with an effective continuum, provides a measure of the degree to which the continuum hypothesis is inapplicable in describing the heat transfer process near the wall. To this end, we estimate this offset temperature via an effective continuum method to all orders in the inclusion volume fraction c of the composite, as well as find its exact value when c is small. Finally, we illustrate how these results may be applied to other problems in which the continuum assumption becomes invalid using, as an example, the problem of finding the rate of heat conduction from a heated sphere surrounded by a composite.

37504 **Pseudo-two-dimensional steady state two-phase flow model for gas-solids vertical pneumatic conveying systems.** Adewumi, M.A.; Arastoopour, H. New York, NY; American Institute of Chemical Engineers (1985). 34p. (CONF-851123—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers annual winter meeting; Chicago, IL, USA (10 Nov 1985).

A pseudo-two-dimensional steady state two-phase flow model is used to describe co-current upward vertical flow of gas and solid particles. It incorporates viscous dissipation terms in both phases. Numerical solution was obtained using the method of lines. The calculated pressure, gas and solid velocity profiles and concentration under different operating conditions agree with the observed physical behavior of the system reported in the literature. The solid velocity profiles calculated using our model agree reasonably well with experimental data.

## 4205 Materials Testing

*REFER ALSO TO CITATION(S) 36773, 36780, 36805, 36810, 37009, 37284, 37285, 37579*

37505 **(HEDL-SA—3673-FP) Elastic creep-fatigue evaluation for ASME [American Society of Mechanical Engineers] code.** Severud, L.K.; Winkel, B.V. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76FF02170. 9p. (CONF-870812—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009968.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Reassessment of past ASME N-47 creep-fatigue rules have been under way by committee members. The new proposed elastic creep-fatigue methods are easier to apply than those previously in the code case. They also provide a wider range of practical application while still providing conservative assessments. It is expected that new N-47 code rules for elastic creep-fatigue evaluation will be adopted in the near future.

37506 **(LBL—23508) Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field.** Bielecki, A. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 222p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87010850.

This dissertation is about nuclear magnetic resonance (NMR) spectroscopy in the absence of applied magnetic fields. NMR is usually done in large magnetic fields, often as large as can be practically attained. The motivation for going the opposite way, toward zero field, is that for certain types of materials, particularly powdered or polycrystalline solids, the NMR spectra in zero field are easier to interpret than those obtained in high field. 92 refs., 60 figs., 1 tab.

37507 **(PB—87-173118/XAB) Computer-aided radiograph analysis.** Lees, D.E.B. (Automatix, Inc., Billerica, MA (USA)). Sep 1984. 49p. NTIS, PC A03/MF A01.

The study examined the feasibility of using interactive digital image processing to analyze radiographs. The objectives were to: demonstrate rapid multiple camera digitization of film radiographs; develop and test interactive multiple window, nonlinear contrast enhancement algorithms; develop and test algorithms for quantitative radiograph quality measurement; and develop and evaluate defect-screening algorithms. Interactive software was developed to make dimensional measurements on digitized images. Good results were shown for rapid digitization, contrast enhancement, and defect screening.

37508 **(SAND—86-2774C) Random control at $n^2$ points using n shakers.** Paez, T.L.; Smallwood, D.; Buksa, E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-870566—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005849.

From Institute of Environmental Sciences annual meeting; San Jose, CA, USA (4 May 1987).

Until recently, random vibration tests performed in the laboratory were typically run using single-point control with the excitation generated using one vibration exciter. Recently, a method was developed for the coherent control of multiple vibration exciters. This new method for testing permits the simultaneous control of the autospectral density of motion at n points on a structure, and the cross-spectral density of motion between every pair of control points. It is shown in this paper that use of the present control technique also permits random vibration control of the autospectral density at $n^2$ points during an n-shaker test.

37509 **(UCRL—94791) Measurement of x-ray dielectric constants with coherent transition radiation.** Moran, M.J.; Dahling, B.A.; Piestrup, M.A.; Berman, B.L.; Kephart, J.O. (Lawrence Livermore National Lab., CA (USA); Adelphi Technology, Woodside, CA (USA); George Washington Univ., Washington, DC (USA). Dept. of Physics; Stanford Univ., CA (USA). Dept. of Electrical Engineering). 6 Jun 1986. Contract W-7405-ENG-48. 8p. (CONF-860880—54). NTIS, PC A02. File Number DE87009947.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A technique for measuring the energy-resolved angular distribution of longitudinally coherent transition radiation generated in multiple-foil targets has been developed. This paper will demonstrate how data generated by these measurements can be used to determine the dielectric constants of materials in the soft x-ray spectral region.

## 4208 Electronic Circuits And Devices

37510 **(BARC—1278) A circuit for characterization of ferroelectrics.** Gadkari, S.C.; Sabharwal, S.C. (Bhabha Atomic Research Centre, Bombay (India). Technical Physics and Prototype Engineering Div.). 1985. 20p. NTIS (US Sales Only), PC A02. File Number DE87900808.

The report describes a circuit developed which enables simultaneous recording of all the hysteresis parameters and domain switching times of ferroelectric materials with respect to the applied electric field or sample temperature. It also allows inputting of the hysteresis loop directly into an X-Y recorder. The theory of measurement and circuit operation has been described for this technique.

37511 **(CONF-8705108—1) Some applications of phasor measurements to adaptive protection.** Thorp, J.S.; Phadke, A.G.; Horowitz, S.H.; Begovic, M.M. (Cornell Univ., Ithaca, NY (USA); Virginia Polytechnic Inst., Blacksburg (USA); AEP Service Corp., Columbus, OH (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02. File Number DE87009823.

From Power industry computer applications conference; Montreal, Canada (19 May 1987).

The application of microprocessor based phasor measurements to new adaptive protection schemes is presented. The concepts of digital adaptive protection in which relay characteristics are modified in response to external signals and conditions in the system are examined. The importance of real-time phasor measurements in adaptive protection systems is illustrated by two examples. The first involves obtaining synchronizing information about phasor measurements to be used in a new type of current differential protection for a multiterminal line. By estimating the reference angles for the phasor measurements the effect of synchronized sampling can be obtained without the expense of synchronizing equipment. The second use of phasor measurements in adaptive protection is the adaptive setting of out-of-step blocking and tripping. Traditional problems of setting out-of-step blocking and tripping are caused because the settings are, of necessity, compromises based on off-line studies. By reacting to real-time phasor measurements from selected buses in interconnection it is shown that improved out-of-step blocking and tripping is possible. 24 refs., 8 figs.

37512 **(CONF-8705117—1) Thermal noise in linear passive multiports.** Agouridis, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 26p. NTIS MF A01; 2; GPO Dep. File Number DE87010022.

From 9. international conference on noise in physical systems; Montreal, Canada (25 May 1987).

The noise temperature of a linear passive multiport is related to the temperatures of the terminations of its input ports and the temperature of the multiport itself. In reciprocal multiports the noise contributions of these sources are not correlated, but may be correlated in non-reciprocal multiports.

37513 **(LBL—23512) Ion beam characterization of thin film metal/GaAs interface reactions.** Yu, Kin Man. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 217p. NTIS, PC A10. File Number DE87011841.

The thermally activated interface interactions of (100) GaAs and thin films of near noble metals (Co, Rh, Ir, Ni, Pd and Pt) and refractory metals (Ti, Zr, V, Nb, Cr, Mo and W) were systematically investigated. Results of this study indicate that interface reactivity and the reacted phase distribution of metal/GaAs contacts were dependent on the electronegativity differences between the metal and the substrate as well as the metal-metal bond strength of the metal. For near noble metals which are very electronegative ($X \geq 1.8$) and have relatively weak M-M bonds, reactions between metal and GaAs were inhibited at low temperatures ($\leq 350°C$). For refractory metals which are relatively electropositive ($X \leq 1.8$) and have stronger M-M bonds, the metal/GaAs interfaces were relatively inert (reactions observed at temperatures $\geq 450°C$). It was also found that for metals with absolute value of X/sub M/ - X/sub Ga/ not equal to absolute value of X/sub M/ - X/sub As/, a layer

sequence of M-Ga/M-As/GaAs was always observed after reactions. A relationship between the interface reactivity and the activation energy of reactions for refractory metal/GaAs contacts was proposed. The electrical properties of metal/n-GaAs diodes were also correlated with the M/GaAs solid phase reactions. Important issues of the solid-state reactions of metal/GaAs contacts such as the phase formation sequence, reaction kinetics, and the distribution and stability of the different M-Ga and M-As phases are discussed in detail.

37514 **(LBL—23536) A TEM [transmission electron microscopy] study of rhodium on GaAs: Reactions and morphology.** Packer, S. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012032.

The interfacial reaction between rhodium films and n-type GaAs in the temperature range of 300 to 700°C has been examined using TEM and electron diffraction methods. The reaction between Rh and GaAs produces a layered structure of Rh/RhGa/$RhAs_2$/GaAs based on RBS and TEM. Above 300°C, the RhGa phase has an orientation relationship of [011]RhGa// [100]GaAs. In cross section, an interpenetrated layered structure was observed with equiaxed RhGa above columnar grains of RhAs2. Rhodium is the moving species as suggested by Kirkendall voiding observed at the RhGa interface. The activation energy of the reaction was calculated to be 1.35 eV. The interface between the reacted layer and GaAs was smooth at 450° and 20 minutes of annealing but showed 10 nm periodic penetrations when annealed at 400° for 90 minutes. Interface roughness may influence the low barrier height reported for the Rh Schottky diode annealed at 400°.

37515 **(SAND—86-0587) The Thermal Flash Protection System, low pass filter JN175666A1.** Washington, L.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011609.

This report discusses the development of the JN175666A1 Low Pass Filter used in the B1-B Thermal Flash Protection System. It also discusses problems encountered during development of the ceramic capacitors and how they were resolved. Included in this report is a description of the filter, the electrical and environmental tests, why they were performed and data accumulated during the development testing. After completing the evaluation of this device, it is concluded that the JN175666A1 filter is a usable component for the B1-B system.

37516 **(SAND—87-0403C) On ion induced hard errors in dielectric structures.** Wrobel, T.F. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006129.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Heavy ion induced failures in $SiO_2$ and $SiO_2/Si_3N_4$ composite capacitors were studied for LETs ranging from 15 to 85 MeV/mg/cm². It was found that: (1) the electric field in the $SiO_2$ along the ion path controls failure, (2) that a threshold energy for failure exists and has contributions from the ion and conduction through the dielectric and (3) the energy threshold is independent of temperature. 6 refs., 4 figs., 2 tabs.

37517 **(SAND—87-1632C) GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature (T > 300°C), power electronic applications.** Zipperian, T.E.; Brennan, T.M.; Hammons, B.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-870679—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011320.

From 5. symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

Solid-state devices formed from compound semiconductor materials like GaAs, GaP, SiC, and (Al,Ga)As have long been viewed as candidates for use in electronic circuits functioning at temperatures greater than 300°C. To address the specific needs of power semiconductor devices operating simultaneously at high currents, voltages, and high temperatures, heterojunction devices formed from combinations of GaAs and (Al,Ga)As have recently been proposed. These novel heterojunction structures display reduced resistive and voltage parasitics when compared to wide-bandgap GaP or SiC, homojunction diodes without seriously compromising control of thermally generated leakage currents. In this study, a prototype, low-power, (Al,Ga)As/GaAs, heterojunction bipolar transistor (HBT) is described which has demonstrated excellent electrical characteristics in the 300 to 400°C temperature range. At 350°C, the HBT has a common-emitter current gain of 14 (V/sub CE/ = 5V, I/sub C/ = 10 mA) and collector-base leakage of 6.4 x $10^{-3}$ A/cm² (V/sub CB/ = 5 V).

37518 **(UCID—21075) A high gain free electron laser amplifier design for the Alcator-C tokamak.** Jong, R.A. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011600.

We describe an improved wiggler tapering algorithm and the resulting wiggler design for a high-gain free electron laser amplifier to be used for plasma heating and current drive experiments in the Alcator-C tokamak. Unlike the original, this new design limits the growth of the shot noise to insignificant levels. The design goal of at least 8 GW of peak power in the TE/sub 01/ mode was achieved with a 3 kA electron beam with energies in the 7 to 9 MeV range and a beam brightness of $10^8$ A/(rad-cm)². The wiggler was 5 m long with a wiggler wavelength of 8 cm.

37519 **Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors.** Hughes, R.C.; Schubert, W.K.; Zipperian, T.E.; Rodriguez, J.L.; Plut, T.A. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 3, 1074-1083(1 Aug 1987). Contract AC04-76DP00789.

The addition of Ag to Pd in the gate metal of a metal-insulator-semiconductor gas sensing diode can improve the performance and change the selectivity of the sensors for a variety of reactions. Data on the response of diodes with 12 different ratios of Ag to Pd in alloys and layers of Pd and Ag to hydrogen and other gases are reported. Diodes with as much as 32% Ag respond very well to $H_2$ gas and the films are much more durable to high hydrogen exposure than pure Pd films. Improvements in the rate of response and aging behavior are found for certain Ag combinations; others give poorer performance. The presence of Ag on the surface changes the catalytic activity in some cases and examples of $H_2$ mixed with $O_2$ and/or $NO_2$, propylene oxide, ethylene, and formic acid are given. Such selectivity forms the basis for miniature chemical sensor arrays which could analyze complex gas mixtures.

37520 **Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors.** Rye, R.R.; Ricco, A.J. (Sandia National Laboratory, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 3, 1084-1092(1 Aug 1987). Contract AC02-80ER10746.

Hydrogen sensitive Pd metal/insulator/semiconductor diodes provide an ambient temperature, low power electronic sensor for hydrogen as a result of hydrogen trapping at the Pd/insulator interface. Current kinetic models consider the rate limiting step to be adsorption at the Pd surface followed by rapid transport to the interface. We have obtained both steady-state and kinetic results for diodes with clean Pd surfaces over hydrogen pressures ranging from $10^{-10}$ to $10^{-1}$ Torr. The sensitivity limit (equivalent to $<10^{11}$ total $H_2$ impacts/cm² at the Pd surface) is set by our vacuum capabilities, and is at least seven orders of magnitude greater than that obtained for devices with contaminated surfaces. These results clearly show that the kinetic and sensitivity limitations reported for such devices are a result of surface contamination. For diodes with a clean Pd surface, analysis of the steady-state results requires at least two binding states (9 and 6.8 kcal/mol of H relative to H/sub 2(//sub g//sub )/) for H at the Pd/$SiO_2$ interface. The kinetics of the diode response to $H_2$ are inconsistent with direct transfer to the bulk exclusively through strong chemisorbed surface states, but suggest with a "precursor" mechanism in which the initial step is adsorption into a weakly bound precursor state from which branching steps populate both strongly bound chemisorbed surface states and bulk states. The surface states act in part as traps for hydrogen

in competition with transfer to the bulk (and therefore to the electronically active interface).

## 4209 Waste Processing Plants And Equipment

*REFER ALSO TO CITATION(S) 37708*

**37521 (BMFT-FB-T—86-125) Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report.** Walter, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 86p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770174.

As part of the activities for development of new technologies for thermal waste treatment, which are supported by the BMFT, a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy was, as a first step, constructed on the premises of the P+S Steelworks in Salzgitter by the company Salzgitter-Pyrolyse GmbH, which was also in charge of the commissioning and trial run. The report deals with the course of the project, a process design, the plant concept and the results of the commissioning and trial run. Included is a report on the problems encountered and how these were overcome. With 30 figs.

## 4210 Combustion Systems

*REFER ALSO TO CITATION(S) 36332, 36354, 36362, 36368, 36461, 36463, 36606, 36607, 36608, 36991, 37124, 37208, 37444, 37500, 37649, 37708*

**37522 (PB—87-179255/XAB) Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987.** Srivastava, R.K.; Mulholland, J.A. (Acurex Corp., Research Triangle Park, NC (USA)). Apr 1987. 28p. NTIS, PC A03/MF A01.

This paper discusses the evaluation of a multistaged combustion burner design on a 0.6-MW package boiler simulator for in-furnace nitrogen oxides (NOx) control and high combustion efficiency. The adiabatic precombustion-chamber burner was reduced in size by a factor of about 2. Natural gas, doped with ammonia to yield a 5.8% fuel nitrogen content, was used to simulate high nitrogen content fuel/waste mixtures. A burner baseline NO emission of 315 ppm (measured dry, corrected to zero % $O_2$) was measured, compared with an emission of over 1000 ppm estimated for a conventional unstaged burner. Both deep air staging, resulting in a three-stage configuration, and boiler front-wall fuel staging of undoped natural gas, yielding four stoichiometric zones, reduced the baseline NO emission by about 50% to 160 ppm, meeting the program goal. However, deep air staging resulted in the entire front end of the boiler being fuel-rich and required penetrations into the boiler for staged air injection. The fuel staging results, on the other hand, required no boiler penetrations and only a small fuel-rich flame core in the boiler. Further, sufficient air for complete oxidation of the primary combustion products was provided at the burner exit, prior to staged fuel and air injection in the boiler, in the fuel-staging tests.

**37523 (UCRL—96437) Response of a pulse combustor to changes in total ignition delay time.** Keller, J.O.; Westbrook, C.K.; Bramlette, T.T.; Dec, J.E. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1987. Contract W-7405-ENG-48. 7p. (CONF-870541—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008843.

From Combustion fundamentals and applications: spring technical meeting of the Central States Section of the Combustion Institute; Argonne, IL, USA (11 May 1987).

The response of a valved pulse combustor to changes in the relative timing between the resonant pressure wave and the energy release rate is examined. Experiments were performed in which measurements of combustion chamber pressure, operating frequency, and spatially-integrated, time-resolved ensemble-averaged <OH*> chemiluminescence were made. The total time interval required for energy release is divided into a fluid dynamic species mixing time, a second fluid dynamic mixing time between cold reactants and hot reaction products, and a homogeneous chemical kinetic ignition delay time. Each of these time scales is varied independently, as well as the characteristic resonance time of the pulse combustor. It is shown that each time scale can be varied separately to optimize the operation of the pulse combustor. All of these system responses are interpreted in terms of Rayleigh's Criterion. In addition, theoretical models for the fluid dynamic mixing process and the chemical kinetic ignition delay are used to determine actual values for the time scales for some of these subprocesses.

**37524 Molybdenum resistance heater.** Lindemer, T.B. (Chemical Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **58**: No. 8, 1533-1533(Aug 1987). Contract AC05-84OR21400.

This note describes an inexpensive and expendable molybdenum heater that can be used as a direct replacement for much more expensive heaters in the smaller commercial resistance heated furnaces.

## 4230 Marine Engineering

*REFER ALSO TO CITATION(S) 36679, 37456*

## 4240 Pollution Control Equipment

*REFER ALSO TO CITATION(S) 37609, 37610*

**37525 (DFVLR-FB—87-04) Instrument for the quasi-continuous determination of the atmospheric soot content.** Neureither, B.; Lidl, J.; Paffrath, D. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere). 1987. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770175.

An instrument for the measurement of soot immissions was developed and calibrated. The method is suitable for the determination of soot concentrations in the range between 0.1 and > 100 μg/m/sup 3/ of air. It is based on the the measurement of light absorption in soot particles deposited on glass fiber filters. With 16 figs., 4 tabs., 7 refs.

**37526 (NP—7770112) Influence of the electrolyte concentration on the absorption of the NO/sub x/ components N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ in aqueous solutions.** Deiss, K.-H. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). 13 Feb 1986. 189p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87770112.

If wet absorption techniques are used for NO/sub x/ removal, the two species N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ are quite important within the complex mechanism of mass transfer, even if their equilibrium concentration is comparably low. N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ are more prone to chemisorption than NO/sub 2/ or NO (which is soluble only by physical methods). In general, the absorption agent will be circulated for some time in technical washers or columns, so that considerable electrolyte concentrations may be accumulated. The author intended to obtain information concerning the influence of the electrolyte concentration in the absorption agent on the parameters determining the liquid-side mass transfer of the components N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/.

## 4250 Power Cycles

**37527 (CONF-870804—17) Predicting toluene degradation in organic Rankine-cycle engines.** Cole, R.L.; Demirgian, J.C.; Allen, J.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02. File Number DE87011385.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

This paper describes the measurement of toluene degradation in dynamic loop tests that simulate operation of an organic Rankine-cycle engine. Major degradation products and degradation mechanisms are identified, and degradation is quantified. Results indicate that toluene is a stable fluid with benign degradation products, provided that oxygen is excluded from the engine. A means of predicting degradation in the engine is developed. 3 refs., 4 figs., 5 tabs.

# 43 PARTICLE ACCELERATORS

*REFER ALSO TO CITATION(S) 38232*

## 4301 Design, Development, And Operation

*REFER ALSO TO CITATION(S) 37492*

37528 **(AD-A—179269/6/XAB) Superconducting augmented rail gun (SARG). Final technical report.** Homan, C.G.; Scholz, W. (Army Armament Research and Development Command, Watervliet, NY (USA). Benet Weapons Lab.). Feb 1987. 21p. (ARCCB-TR—87003). NTIS, PC A02/MF A01.

Both the energy efficiency and projectile velocity of a railgun system can be substantially increased by the addition of an adjunct superconducting augmentation coil system. The energy efficiency results from the superconducting coil's ability to recover the rail magnetic field energy normally dissipated at the end of launch in rail guns, by means of a unique application of the flux conservation of property of superconducting coils. The increased velocity results from the augmented Lorentz force due to the augmentation-coil magnetic field. In an idealized system, both the energy efficiency and projectile velocities can be increased by more than 80%, dependent on the magnetic coupling between the rail and augmentation coils. The theoretical evaluation was extended to include dissipative effects which reveal that actual launch efficiencies are increased from 25% (rail gun) to over 50% (SARG). A theoretical analysis of SARG is presented here together with the progress of an experimental demonstrator developer at Benet Weapons Lab.

37529 **(DOE/ER/40150—1) The CEBAF [Continuous Electron Beam Accelerator Facility] project.** Gross, F.; Mecking, B. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1985. Contract AC05-84ER40150. 23p. (CEBAF—85-004; CONF-850318—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008676.

From 2. workshop on perspectives in nuclear physics at intermediate energies; Trieste, Italy (25 Mar 1985).

An overview is given of the Continuous Electron Beam Accelerator Facility (CEBAF) project. The proposed physics program at CEBAF is also discussed. Some examples are presented for physics problems that drive the requirements for the experimental facilities, and possible solutions are given. (LEW)

37530 **(DOE/ER/40150—8) The CEBAF [Continuous Electron Beam Accelerator Facility] superconducting accelerator: An overview.** Leemann, C.W. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 8p. (CEBAF-PR—86-003; CONF-860629—72). NTIS, PC A02. File Number DE87008674.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The CEBAF accelerator is a CW linac based on rf superconductivity and making use of multiple recirculation. Its major components are a 50 MeV injector, two linac segments of 0.5 GeV energy gain each, and recirculator arcs connecting the two linac segments. Each linac segment consists of 25 cryomodules, separated by warm sections with quadrupoles, steering magnets, and beam diagnostics. Each cryomodule contains 8, 1500 MHz, 5-cell, Cornell type cavities with waveguide couplers for fundamental power and HOM damping, each cavity being powered by its own klystron. Recirculator arcs are vertically stacked, large radius, strong focusing beam lines that minimize synchrotron radiation effects. A high quality ($\Delta E/E \sim 10^{-4}$, $\epsilon \sim 10^{-9}$ m) beam of 200μA, 100% duty factor, with 0.5 GeV ≦ E ≦ 4.0 GeV will be generated.

37531 **(DOE/ER/40150—24) The CEBAF [Continuous Electron Beam Accelerator Facility] control system architecture.** Bork, R. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 5p. (CEBAF-PR—87-004). NTIS MF A01; 2; GPO Dep. File Number DE87008666.

The focus of this paper is on CEBAF's computer control system. This control system will utilize computers in a distributed, networked configuration. The architecture, networking and operating system of the computers, and preliminary performance data are presented. We will also discuss the design of the operator consoles and the interfacing between the computers and CEBAF's instrumentation and operating equipment.

37532 **(DOE/ER/40150—29) The Continuous Electron Beam Accelerator Facility.** Grunder, H.A.; Bisognano, J.J.; Diamond, W.I.; Hartline, B.K.; Leemann, C.W.; Mougey, J.; Sundelin, R.M.; York, R.C. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 8p. (CEBAF-PR—87-017). NTIS MF A01; 2; GPO Dep. File Number DE87008664.

On February 13, 1987, construction started on the Continuous Electron Beam Accelerator Facility - a 4-GeV, 200-μA, continuous beam, electron accelerator facility designed for nuclear physics research. The machine has a racetrack configuration with two antiparallel, 500-MeV, superconducting linac segments connected by beam lines to allow four passes of recirculation. The accelerating structure consists of 1500-MHz, five-cell niobium cavities developed at Cornell University. A liquid helium cryogenic system cools the cavities to an operating temperature of 2 K. Beam extraction after any three of the four passes allows simultaneous delivery of up to three beams of independently variable currents and different, but correlated, energies to the three experimental areas. Beam breakup thresholds exceed the design current by nearly two orders of magnitude. Project completion and the start of physics operations are scheduled for 1993. The total estimated cost is $255 million.

37533 **Proton accelerator for medical applications.** Martin, R.L. (Argonne National Lab., IL, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: 1087-1091(Apr 1987). (CONF-861114—). Contract W-31-109-ENG-38.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The conceptual design of a proton synchrotron for radiation treatment of cancer in a hospital is described. The proton energy would be variable on a pulse-pulse basis up to 250 MeV with a maximum accelerated current of 60 nA average at a 5 Hz repetition rate. The ring would consist of a number of small straight magnets for ease of construction and flexibility of arrangement of dipoles, quadrupoles, and drift spaces. The ring would be 23 ft in diameter. The same magnets (2 times the number) could also be arranged in a ring of twice the diameter. The synchrotron would then accelerate helium ions to 250 MeV/μ, suitable for the full range of radiation treatment. A major feature of this larger synchrotron, which is the one described below, is the ability to accelerate negative hydrogen ions to 250 MeV (with lower peak magnetic fields to avoid magnetic stripping of the ions) and utilize charge exchange extraction. The latter technique appears to be most promising for satisfying the requirements for dynamic raster scanning of narrow proton beams.

37534 **SLAC site design aesthetics.** Hall, F. (Stanford Linear Accelerator Center (SLAC), Stanford Univ., Stanford, CA 94305). pp 515-528 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Stanford Linear Accelerator Center (SLAC) is a single mission laboratory dedicated to basic research in high energy particle

physics. SLAC site also houses Stanford Synchrotron Radiation Laboratory (SSRL) which is a multi-mission laboratory for research using beams of ultraviolet light and low energy photons as emitted tangentially from SLAC colliding beam facilities. This paper discusses various aspects of SLAC site design aesthetics under following headings: imposed footprint of SLAC; description of Selected Site; use of earth cover for radiation and sight screens; use of landscaping for cosmetic purposes; use of exterior paint colors to soften SLAC impact on neighbors; relocation of SLAC main entrance; relocation of SLAC collider arcs and experimental hall; parking lots and storage yards; and land use zoning at SLAC.

37535 **The future of electron-positron colliders.** Richter, B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 128-133 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—). Contract AC03-76SF00515.

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

This paper is an abbreviated version of a lecture given at the Snowmass meeting of the Division of Particles and Fields of the APS. Included here are SLAC's plans for the Stanford Linear Collider and the authors speculation on the development of the e/sup +/e/sup -/ machines beyond the SLC or LEP that will be required to further advance the state of particle physics.

37536 **Conventional 20-TeV, 10-Tesla, p/sup +-/p colliders.** Diebold, R.; Ankenbrandt, C.; Collins, T.; Fisk, E.; Johnson, D.; Mantsch, P.; Peoples, J.; Shafer, R.; Teng, L.; Lambertson, G. (Argonne National Lab., Argonne, IL 60439). pp 307-314 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The performance of various 20-TeV colliders is discussed assuming 10-Tesla bending magnets. For bunched beams, the luminosity for p-barp collisions will be approximately <n> x 10/sup 31/ cm/sup -2/ sec/sup -1/ where <n> is the average number of interaction per bunch collision desired by the experimenters; for pp collisions this becomes <n> x 10/sup 32/ cm/sup -2/ sec/sup -1/. Values of <n> up to 25 can be accommodated in a straightforward manner. Continuous beam pp collisions may yield a luminosity of 10/sup 33/ to 10/sup 34/ cm/sup -2/ sec/sup -1/ if the large amount of energy in the intense beams can be handled. Assuming that adequate and reliable 10-Tesla magnets can be built without unforeseen difficulties, the construction cost of such a collider, together with its new laboratory in the desert, would cost 2 to 3 billion dollars using present-day, "conventional" techniques. Although such a machine appears straightforward to build, considerable R&D will be required in order to optimize the design and bring down costs.

37537 **Accelerator facilities in the 100-1000 TeV range.** Wenzel, W.A. (Lawrence Berkeley Lab., Berkeley, CA). pp 322-328 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The application of current technologies to proton-antiproton colliders of 20, 100 and 1000 TeV is studied. The maximum field in the superconducting magnets is 2 or 5 Tesla. The facility also includes a conventional ring for electrons and positrons with two to three orders of magnitude less energy. A unique injector employs a rapid cycling, variable tune superconducting ring to accelerate particles from 10 GeV to the minimum operating momentum of the storage accelerator. The scaling of costs with momentum is minimized in several ways. Extensive beam-beam feedback for orbit control permits the use of small apertures. The very long magnets are produced on a linear assembly line. Finally, the accelerators are combined into a three ring circus maximus within a single neutral buoyance cryostat supported in a water-pipe tunnel of small diameter.

37538 **1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components.** Mantsch, P. (Fermilab National Accelerator Lab., Batavia, IL 60510). pp 335 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Some possible machine options for the near term (before 1990) exploit Saver technology and existing production capability. Using Saver components in a new tunnel dedicated p-barp or pp storage rings could be constructed relatively quickly and at modest cost. Production of magnets for a 1 km ring (774 dipoles and 200 quadrupoles) would require two years using the existing magnet factory. During the magnet production, tunnel and experimental facility construction could proceed. Installation and commissioning of the ring and the installation of experiments would require another year. If magnet production were to proceed for two more years and a year allowed for installation of the second ring, a pp facility could be realized. An accompanying table shows cost estimates for a collider based on our experience with the Energy Saver. R and D and EDIA are not included in the cost estimates. Some of these costs, however, have already been absorbed in the Saver project. The Saver magnet costs used are averages over the production period. The magnet costs for an extended production run would probably be lower and would certainly cover any contingency. No spares are included.

37539 **High energy physics at Brookhaven National Lab.** Samios, N.P. (Brookhaven National Lab., Upton, NY 11973). pp 140-145 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The AGS is supporting an exciting, vibrant, and vital program. There are at present two modes of operation, Fast Extracted Beam (FEB) with a 1.4 second repetition rate and Slow Extracted Beam (SEB) with a 2 second repetition rate. The average intensity is 8 x 10/sup 12/ protons per pulse with peaks at 10/sup 13/ ppp. The FEB mode is mainly utilized for neutrino physics involving large detectors, 100-200 tons, placed at varying distances from the target, 300 meters and 1 kilometer. In the slow mode there is a one second flat top during which the beam emerges uniformly in time and it is split into four target stations: A, B, C, and D. These four are simultaneously illuminated and the fractions on each can be varied. A listing of the types of approved experiments is presented with their appropriate beam locations. The experimental program ran for 22 weeks. Over 200 users practice their trade at the AGS and the program is sufficiently rich that there is a reasonable chance that one or more experimenters will uncover new results that will change the way we think about particle physics.

## 4302 Beam Dynamics, Field Calculations, And Ion Optics

*REFER ALSO TO CITATION(S) 37554, 37557*

37540 **(BNL—39593) Tranverse beam break up in a periodic linac.** Decker, G.; Wang, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870302—184). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010053.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The problem of cumulative beam break up in a periodic linac for a general impedance is discussed, with the effects of acceleration included. The transverse equations of motion for a set of identical point like bunches moving along the length of the linac are cast into a simple form using a smooth approximation. This re-

sults in a working formula that is used to analyze beam breakup. Explicit expressions for the transverse motion in the case of a single resonance impedance are found using saddle point integration. This is done first with no external focusing, and again in the strong focusing limit.

37541 **(DOE/ER/40150—7) Multipass beam breakup in the CEBAF [Continuous Electron Beam Accelerator Facility] superconducting linac.** Bisognano, J.J.; Krafft, G.A. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 2 Jun 1986. Contract AC05-84ER40150. 6p. (CEBAF-PR—86-001; CONF-860629—73). NTIS, PC A02. File Number DE87008678.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Multipass beam breakup can severely limit current in superconducting linear accelerators due to the inherently high Q's of transverse deflecting modes of the rf cavities. The success of higher-order-mode damping in increasing threshold currents for the 4-pass CEBAF SRF linac design is investigated with computer modeling. This simulation is shown to be in agreement with theoretical analyses which have successfully described beam breakup in the Stanford superconducting, recirculating linac. Numerical evaluation of an analytic treatment by Gluckstern of multipass beam breakup with distributed cavities is also found to be consistent with the computer model. Application of the simulation to the design array of 400 five-cell CEBAF/Cornell cavities with measured higher-order-mode damping indicates that the beam breakup threshold current is at least an order of magnitude above the CEBAF design current of 200 $\mu$A.

37542 **(DOE/ER/40150—27) Optics of beam recirculation in the CEBAF [Continuous Electron Beam Accelerator Facility] cw linac.** Douglas, D.R. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 3p. (CEBAF-PR—86-002; CONF-860629—74). NTIS, PC A02. File Number DE87008673.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The use of recirculation in linear accelerator designs requires beam transport systems that will not degrade beam quality. We present a design for the transport lines to be used during recirculation in the CEBAF accelerator. These beam lines are designed to avoid beam degradation through synchrotron radiation excitation or betatron motion mismatch, are insensitive to errors commonly encountered during beam transport, and are optimized for electron beams with energies of 0.5 to 6.0 GeV. Optically, they are linearly isochronous second order achromats based on a "missing magnet" FODO structure. We give lattice specifications for, and results of analytic estimates and numerical simulations of the performance of, the beam transport system.

37543 **(FNAL-TM—1444) Simulation of space charge effects and transition crossing in the Fermilab Booster.** Lucas, P.; MacLachlan, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 4p. (CONF-870302—147). NTIS, PC A02. File Number DE87009031.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The longitudinal phase space program ESME, modified for space charge and wall impedance effects, has been used to simulate transition crossing in the Fermilab Booster. The simulations yield results in reasonable quantitative agreement with measured parameters. They further indicate that a transition jump scheme currently under construction will significantly reduce emittance growth, while attempts to alter machine impedance are less obviously beneficial. In addition to presenting results, this paper points out a serious difficulty, related to statistical fluctuations, in the space charge calculation. False indications of emittance growth can appear if care is not taken to minimize this problem.

37544 **Calculated fraction of an incident current pulse that will be accelerated by an electron linear accelerator and comparisons with experimental data.** Alsmiller, R.G. Jr.; Alsmiller, F.S.; Lewis, T.A. (Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research;* **256**: No. 3, 409-417(15 May 1987). Contract AC05-84OR21400.

Also published as report ORNL/TM--10010.

In a series of previous papers, calculated results obtained using a one-dimensional ballistic model were presented to aid in the design of a prebuncher for the Oak Ridge Electron Linear Accelerator. As part of this work, a model was developed to provide limits on the fraction of an incident current pulse that would be accelerated by the existing accelerator. In this paper experimental data on this fraction are presented and the validity of the model developed previously is tested by comparing calculated and experimental data. Part of the experimental data is used to fix the physical parametrs in the model and then good agreement between the calculated results and the rest of the experimental data is obtained.

37545 **Beamstrahlung from colliding electron-positron beams with negligible disruption.** Noble, R.J. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Instruments and Methods in Physics Research;* **256**: No. 3, 427-433(15 May 1987). Contract AC03-76SF00515.

We present radiative energy loss formulas for beamstrahlung from colliding electron-positron beams which experience negligible disruption, as determined by numerical simulation. Our computer code uses the correct quantum mechanical photon number spectrum for synchrotron radiation emitted by relativistic electrons to simulate with macroparticles the discrete nature of photon emission. For Gaussian beams with small average electron energy loss, we determine energy loss formulas valid for all radiation regimes from classical to extreme quantum mechanical which depend on only two beam parameters, a quantum radiation parameter Y/sub 0/ and a beam energy per unit length, Γ/sub 0/.

37546 **Luminosity of continuous beams with crossing angle.** Smith, L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 351-352 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

Since it appears difficult to reach a luminosity of even 10/sup 32/ cm/sup -2/ sec/sup -1/ with (p, p-bar) in a single ring if the number of events per bunch collision should not exceed unity, it seems appropriate to ask what could be done with two continuous beams in independent rings, ISR style. This subject was treated at some length previously, based on an optimization procedure developed earlier. In this paper, a different approach is taken by considering the length of the interaction diamond and the luminosity to be of primary importance and relating the other parameters to them.

## 4303 Auxiliaries And Components

*REFER ALSO TO CITATION(S) 37561, 38166*

37547 **(CONF-870498—3) Recent electronic improvements to the Oak Ridge 25URC accelerator.** Ziegler, N.F.; Schulze, G.K.; Rochelle, J.W.; Milner, W.T.; Meigs, M.J.; McPherson, R.L.; Juras, R.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008799.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

A new chopper-buncher system has been installed in the 25URC accelerator injection line. The buncher is similar to the one used previously, but incorporates several significant improvements. The chopper is a new device to provide beam pulses for time-of-flight experiments. The accelerator charging system has been modified to increase reliability and improve chain monitoring. A display

unit for beam profile monitors (BPM) is being developed. The display will allow the operator to observe four BPM traces simultaneously.

37548 **(DOE/ER/40150—10) The CEBAF [Continuous Electron Beam Accelerator Facility] cavity cryostat.** Biallas, G.; Brindza, P.; Phillips, H.L.; Kirchgessner, J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA); Cornell Univ., Ithaca, NY (USA)). 1986. Contract AC05-84ER40150. 5p. (CEBAF-PR—86-004; CONF-860629—77). NTIS, PC A02. File Number DE87008659.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The modular design of the linac cryostat system based on a cavity-pair is presented. Description of the cryogenic module consisting of four cavity-pairs is included. The methods of making a cavity-pair hermetic during cryostat assembly, introducing the waveguides, supporting the helium vessels and introducing instrumentation are presented. Also included are the methods of tuning the cavities, aligning them to exterior references and connecting cryogenic fluid circuits to adjacent modules and transfer lines.

37549 **(DOE/ER/40150—13) An optimized input waveguide for the CEBAF [Continuous Electron Beam Accelerator Facility] Superconducting Linac Cavity.** Brindza, P.; Biallas, G.; Phillips, L. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA); Cornell Univ., Ithaca, NY (USA)). 1986. Contract AC05-84ER40150. 6p. (CEBAF-PR—86-009; CONF-860629—78). NTIS, PC A02. File Number DE87008671.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

A thermally optimized input waveguide for the CEBAF Superconducting Linac Cavity, to operate at 2.0K, has been designed. Calculations leading to thermal optimization including conduction, specularly reflected radiation and rf power dissipation are presented. An economic comparison between a thermal intercept and continuous counter flow cooling has been made. Calculations and techniques for reducing specularly reflected radiation are discussed.

37550 (SLAC—306, pp 13-22) **Granlibakken report on the SSP Trigger.** Glanzman, T. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This note describes work in progress on a new trigger component for the Mark II detector at SLC, the SSP Software Trigger (SST). Work on this trigger was motivated by the desire to improve the old TED calorimeter trigger, to provide a (hopefully unnecessary) backup trigger for use in the potentially noisy SLC environment and with the hope of being sensitive to and ultimately finding some new physics. The design of the SST incorporates new hardware and software elements providing flexibility both for combining detector elements into the trigger processor and for the algorithms which ultimately make the trigger decision. Full advantage is taken of the large amount of time between beam crossings at the SLC. A concurrent study of this trigger's potential and consequences is also underway utilizing both PEP and Monte Carlo data.

37551 (SLAC—306, pp 70-88) **Status report on the Mark II Energy Measurement System.** Levi, M. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This report summarizes the status of the Mark II beam-energy measurement project. Considerable progress has been made towards out goal of installation in summer of 1987. In the 10 months since this project was proposed by Joel Kent and enthusiastically received by the collaboration at the Asilomar conference, the author have received approval from the EPAC and within a matter of weeks we will be starting construction. Out plan is to have two spectrometers, one on each extraction-line, which will enable us to achieve an absolute center-of-mass energy resolution of 45 MeV/$c^2$ and a relative resolution (appropriate for width determinations) of 35 MeV/$c^2$. These measurements, combined with measurements from the Mark II detector, will over-constrain the relative energy measurement, permitting a sensitive check of the systematic errors. The plan of this report is as follows. First we review the most salient physics motivations for a precision energy measurement. Following a brief review of how the beam-energy measurement system will operate, we discuss the design for the extraction-lime including the detailed specifications for the magnets and detectors. We show how this scheme forms the backbone for a Moeller polarimeter and can provide valuable diagnostic information for tuning and controlling the machine through the imaging of the beam-beam disruption.

37552 (SLAC—306, pp 420-431) **Beam position measurements at the SLC IP.** Bowden, G.; Burke, D.; Jung, C.K. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Knowledge of the position of the $e^+$ and $e^-$ bunches in all parts of the SLC is important, but this is especially true at the IP where we want the separate bunches to collide. If the collision point is absolutely stable in time, then it would be possible to ultimately find its location with the tracking devices of the Mark II, but this is of little use if we are unable to make the beams collide in the first place. We are working on development of a beam position monitor (BPM) that can be physically centered at the interaction point and that will introduce little material into the path of particles produced at the IP and detectable by the Mark II. The goals for this device are to measure the position of the collision point (in a coordinate system fixed with respect to the Mark II) within a time that is short compared to the $e^+e^-$ event rate, and to measure the relative positions of the electron and positron bunches at the IP with an accuracy that is sufficient to bring the beams into collision.

37553 (SLAC—312, pp 309-348) **Data acquisition for high energy physics experiments.** Breidenbach, M. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The general scope of Data Acquisition Systems range from the feedthroughs on the actual detectors to the storage racks for the data recording media. The systems are concerned with the conversion of interesting, volatile signals usually to a stable, digitized format. The problems involved are interesting because of the boundary conditions: engineering, economics, required resolution and range, rates, radiation damage, and physical size available for the components. Systems that will be considered here are limited to those for $e^+e^-$ and hadronic colliding beam problems. Component tasks of a Data Acquisition System are preamplification and signal conditioning, digitization, sparsification, data correction, data reduction, and data recording. Implementation of these tasks require considerations for buffering of the data, multiplexing of the data paths, and triggering systems to control the Data Acquisition System. These lecture develop a conceptual understanding of the building blocks required for these systems and their relationships to each other in real systems. The approach is pedagogic and a variety of data acquisition issues are introduced. An SLD is used for illustration an SSC detector is briefly considered.

37554 **(SLAC-PUB—4178) Some fast beam kicker magnet systems at SLAC.** Bulos, F.; Cassel, R.L.; Donaldson, A.R.; Genova, L.F.; Grant, J.A.; Mihalka, A.M.; Sukiennick, B.A.; Tomlin, W.T.; Veldhuizen, F.T.; Walz, D.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 4p. (CONF-870302—175). NTIS, PC A02. File Number DE87009457.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Stanford Linear Collider requires very fast rise and fall times from its kicker magnets. The damping rings and positron source need either one or two bunches deflected from two or three that are separated in time by about 59 ns. The final focus region kicker magnets need a rise time of less than 700 ns and each one deflects only one bunch. This paper discusses the design and characteristics of a thyratron-switched, castor-oil-filled, coaxial, Blumlein line used for one bunch kicking. It discharges a 118 ns (at the base), 50 kV, 3 kA pulse into a 33 cm long, ferrite-loaded, kicker

magnet of rectangular coaxial-line geometry, which in turn is terminated by a matched load. Reference is made to a Fermilab (FNAL) designed magnet and a dual-thyratron pulsar that will deflect two serial bunches in or out of the electron ring. Also, a brief description of the final focus magnet is given. Work is continuing on the various subsystem components to decrease the pulse rise and fall time, flattop ripple and jitter and to reduce some of the sources of noise and hv breakdown.

37555 **(SLAC-PUB—4209) Beam trajectory acquisition system for the arcs of the Stanford Linear Collider.** Pellegrin, J.L.; Ross, M.C.; Scott, B.D.; Wilson, D.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—176). NTIS, PC A02. File Number DE87009455.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This report describes the beam position monitoring system of the collider arcs at the Stanford Linear Collider. This beam position monitoring system is different from others at SLAC in its large amount of hardware and its use of ungated, self-triggered electronics. All of the processing electronics are installed in the accelerator tunnel. (JDH)

37556 **(SLAC-PUB—4217) Feedback systems in the SLC.** Thompson, K.A.; Jobe, R.K.; Johnson, R.; Phinney, N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—170). NTIS, PC A02. File Number DE87009454.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Two classes of computer-controlled feedback have been implemented to stabilize parameters in subsystems of the SLC: (1) "slow" (time scales ~ minutes) feedback, and (2) "fast", i.e., pulse-to-pulse, feedback. The slow loops run in a single FEEDBACK process in the SLC host VAX, which acquires signals and sets control parameters via communication with the database and the network of normal SLC microprocessors. Slow loops exist to stabilize beam energy and energy spread, beam position and angle, and timing of kicker magnets, and to compensate for changes in the phase length of the rf drive line. The fast loops run in dedicated microprocessors, and may sample and/or feedback on particular parameters as often as every pulse of the SLC beam. The first implementations of fast feedback are to control transverse beam blow-up and to stabilize the energy and energy spread of bunches going into the SLC arcs. The overall architecture of the feedback software and the operator interface for controlling loops are discussed.

37557 **(SLAC-PUB—4221) Design of a wiggler-focused, sheet beam X band klystron.** Eppley, K.R.; Herrmannsfeldt, W.B.; Miller, R.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—169). NTIS, PC A02. File Number DE87009453.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An X band klystron using a sheet beam and wiggler focusing was simulated using the 2 + 1/2 dimensional particle in cell code MASK. Simulation of the rf cavities was by means of the port approximation used in modelling of standard klystrons. The wigglers, which would need permanent magnets to achieve the required field strengths, were modelled using an idealized analytic expression with an exponential rise and a linear taper superimposed on a sinusoidal variation. Cavity locations and tunings were varied for maximum output power. Beam voltage and current were also varied to explore the effect on efficiency. Both an idealized laminar beam and a more realistic beam from a gun design code were studied. For a voltage of 200 kV and current of 20 amp per linear cm efficiencies of approximately 50% were calculated.

37558 **Moyer model approximations for point and extended beam losses.** McCaslin, J.B.; Swanson, W.P.; Thomas, R.H. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. School of Public Health). *Nuclear Instruments and Methods in Physics Research;* **256**: No. 3, 418-426(15 May 1987). Contract AC03-76SF00098.

The use of empirical Moyer model for the determination of transverse neutron shielding for high-energy proton accelerators is described and discussed. It is shown that an important advantage of the Moyer Model is the physical insight it offers towards understanding the complex interactions that comprise the shielding processes. Calculations for pointlike and extended uniform beam loss distributions are discussed and their relationship to practical shielding conditions developed. The calculations required by the model are readily performed on small programmable calculators and thus are widely accessible. Program listings for practical calculations using a Hewlett-Packard HP-97 calculator are available on request.

37559 **Tunable coherent x-rays.** Attwood, D.; Halbach, K.; Kim, K.J. (Lawrence Berkeley Lab., CA). *Science (Washington, D.C.);* **228**: No. 4705, 1265-1272(14 Jun 1985). Contract AC03-76SF00098.

A modern 1- to 2-billion-electron-volt synchrotron radiation facility (based on high-brightness electron beams and magnetic undulators) would generate coherent (laser-like) soft x-rays of wavelengths as short as 10 angstroms. The radiation would also be broadly tunable and subject to full polarization control. Radiation with these properties could be used for phase- and element-sensitive microprobing of biological assemblies and material interfaces as well as research on the production of electronic microstructures with features smaller than 1000 angstroms. These short wavelength capabilities, which extend to the K-absorption edges of carbon, nitrogen, and oxygen, are neither available nor projected for laboratory XUV lasers. Higher energy storage rings (5 to 6 billion electron volts) would generate significantly less coherent radiation and would be further compromised by additional x-ray thermal loading of optical components.

## 4304 Storage Rings

37560 **(LBL—22189) ZAP and its application to the optimization of synchrotron light source parameters.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 9p. (CONF-870302—172). NTIS, PC A02. File Number DE87009548.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The design of electron storage rings for the production of synchrotron radiation has become increasingly sophisticated in recent years. To assist in the optimization of such storage rings, a new, user-friendly code to treat the relevant collective phenomena, called ZAP, has been written at LBL. The code is designed primarily to carry out parameter studies of electron storage rings, although options for protons or heavy ions are included where appropriate. In this paper, we first describe the contents of the code itself, and then illustrate, via selected examples, how the collective effects treated by ZAP manifest themselves in the new generation of synchrotron light sources.

37561 **(LBL—22193) The magnet lattice of the LBL 1-2 GeV Synchrotron Radiation Source.** Jackson, A. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—173). NTIS, PC A02. File Number DE87009550.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes the magnet chosen for the LBL 1-2 GeV Synchrotron Radiation Source. The structure has a circumference of 196.8 m, with 12 dispersion free straight sections that can accommodate insertion devices up to 5 m long. The achromatic arcs that connect these straight sections feature combined function (gradient) bending magnets. Utilization of three such magnets in the so-called three-bend-achromat (TBA) arrangement, has several beneficial effects: (1) it reduces the amplitude of the vertical beta-function in the bending magnets, thereby minimizing the required aperture; (2) it changes the damping partition number in such a way as to reduce the natural emittance; and (3) it produces separation of the beta-functions such that relatively low sextupole strengths are sufficient for chromatic correction. The result is a structure with very low emittance (4 nm-rad at 1.5 GeV) that is correctable with only two families of sextupoles while maintaining excellent chro-

matic properties and acceptable dynamic aperture. In this paper we describe the details of the storage ring and discuss the characteristic features of the lattice.

37562 **(PB—87-187159/XAB) Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: results of the Fall 1984 test-drilling program. Environmental geology notes.** Kempton, J.P.; Bauer, R.A.; Curry, B.B.; Dixon, W.G.; Graese, A.M. (Illinois State Geological Survey, Champaign (USA)). 1987. 104p. (IL/SGS/ENG—117). NTIS, PC A06/MF A01.

See also PB—86-124989.

More than 2,685 feet of NX wireline bedrock core and 150 split-spoon samples representing 947 feet of glacial drift were recovered from nine test holes drilled in Kane, Du Page, Kendall and De Kalb counties of northeastern Illinois. On-site observations established the lithology, drilling rate, fracture frequency, rock-quality designation, joint and fracture character of the bedrock, and blow counts and approximate unconfined compressive strength for the drift. Post-drilling operations included borehole testing for in-situ geophysical characteristics and permeability. Laboratory tests on bedrock included tensile strength, triaxial strength, and unconfined compressive strength; and on the drift, particle-size distribution and moisture content.

# 44 INSTRUMENTATION

## 4401 Radiation Instrumentation

*REFER ALSO TO CITATION(S) 36561, 36800, 37875, 38198, 38232, 38236*

37563 **(GKSS—86/E/43) Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems.** Fanger, H.U.; Michaelis, W.; Pepelnik, R.; The, H.L. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1986. 10p. NTIS, PC E07; Available from NTIS as TIB/B87-04743.

A radiometric technique for analyzing complex material systems as, e.g., in piple-lines for hydraulic transport of solids, has been developed. The selective attenuation of two common-beam gamma-rays of different energy is utilized to derive, by mathematical combination of the measured intensity data, the individual parts by volume of the constituents. Details of the method, precision and accuracy, the influence of chemical variations and grainsize dependencies on the basis of model predictions and loop experiments are discussed. The first measuring device built for applications was checked in a manganese nodule mining test in the Pacific, another successfully used in a Red Sea pre-pilot mining test, and a third applied at a test facility for hydraulic transport of coal.

37564 **(LBL—23452) Measurement of electron beam polarization at the SLC.** Steiner, H. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 26p. (CONF-8703128—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011103.

From International conference on advances in experimental methods for colliding beam physics; Stanford, CA, USA (9 Mar 1987).

The polarimeters needed to monitor and measure electron beam polarization at the Stanford Linear Collider are discussed. Two types of polarimeters, are to be used. The first is based on the spin dependent elastic scattering of photons from high energy electrons. The second utilizes the spin dependence of elastic electron-electron scattering. The plans of the SLC polarization group to measure and monitor electron beam polarization are discussed. A brief discussion of the physics and the demands it imposes on beam polarization measurements is presented. The Compton polarimeter and the essential characteristics of two Moeller polarimeters are presented. (LEW)

37565 **(MPI-PAE/Exp.El.—156) Low-light-level video system for data acquisition from optical particle detectors.** Aderholz, M.; Brettel, H.; Falkner, S.; Fent, J.; Froechtenicht, W.; Osthoff, A.; Seyboth, J.; Seyerlein, J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Dec 1985. 26p. NTIS, PC E07; Available from NTIS as TIB/B87-03946.

A video system for digitization and registration of particle tracks in the large (2 m x 1.2 m) streamer chamber of the NA5 experiment at the CERN SPS is described. Approximately 250,000 events in three stereoscopic views were scanned, digitized, and then recorded on magnetic tape. A sample of these events were compared with measurements from film. The two-track resolution and the precision proved to be comparable with the film data.

37566 **(N—87-20840) Normal incidence x-ray telescope. Semiannual progress report, 1 May 1985-31 October 1986.** Golub, L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Jan 1987. 23p. (NASA-CR—180107; NAS—1.26:180107; SAPR—6; SAPR—7; SAPR—8). NTIS, PC A02/MF A01.

The postflight performance evaluation of the x-ray telescope was summarized. All payload systems and subsystems performed well within acceptable limits, with the sole exception of the light-blocking prefilters. Launch, flight and recovery were performed in a fully satisfactory manner. The payload was recovered in a timely manner and in excellent condition. The prefilter performance analysis showed that no x-ray images were detected on the processed flight film. Recommendations for improved performance are listed.

37567 **(N—87-20951) Space radiation studies. Annual report, November 1985-November 1986.** Gregory, J.C. (Alabama Univ., Huntsville (USA)). 1986. 56p. (NASA-CR—179037; NAS—1.26:179037). NTIS, PC A04/MF A01.

Instrument design and data analysis expertise was provided in support of several space radiation monitoring programs. The Verification of Flight Instrumentation (VFI) program at NASA included both the Active Radiation Detector (ARD) and the Nuclear Radiation Monitor (NRM). Design, partial fabrication, calibration and partial data analysis capability to the ARD program was provided, as well as detector head design and fabrication, software development and partial data analysis capability to the NRM program. The ARD flew on Spacelab-1 in 1983, performed flawlessly and was returned to MSFC after flight with unchanged calibration factors. The NRM, flown on Spacelab-2 in 1985, also performed without fault, not only recording the ambient gamma ray background on the Spacelab, but also recording radiation events of astrophysical significance.

37568 **(ORNL/TM—10421) Evaluation of a digital optical ionizing radiation particle track detector.** Hunter, S.R. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010582.

An ionizing radiation particle track detector is outlined which can, in principle, determine the three-dimensional spatial distribution of all the secondary electrons produced by the passage of ionizing radiation through a low-pressure (0.1 to 10 kPa) gas. The electrons in the particle track are excited by the presence of a high-frequency AC electric field, and two digital cameras image the optical radiation produced in electronic excitation collisions of the surroundings gas by the electrons. The specific requirements of the detector for neutron dosimetry and microdosimetry are outlined (i.e., operating conditions of the digital cameras, high voltage fields, gas mixtures, etc.) along with an estimate of the resolution and sensitivity achievable with this technique. The proposed detector is shown to compare favorable with other methods for obtaining the details of the track structure, particularly in the quality of the information obtainable about the particle track and the comparative simplicity and adaptability of the detector for measuring the secondary electron track structure for many forms of ionizing radiation over a wide range of energies.

37569 **(PNL-SA—14244) Achieving ultralow background in a germanium spectrometer.** Brodzinski, R.L.; Reeves, J.H.; Avignone, F.T. III; Miley, H.S. (Pacific Northwest Lab., Richland, WA (USA); South Carolina Univ., Columbia (USA)). Mar 1987. Contract AC06-76RL01830. 14p. (CONF-870430—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012025.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A germanium diode gamma-ray spectrometer has been constructed that exhibits background levels three orders of magnitude lower than conventional low-background laboratory spectrometers in the energy region around 100 keV and five orders of magnitude lower in the energy region above 3 MeV. The steps necessary to achieve this reduction are described, and the application of this technology to construction of ultralow background laboratory based germanium diode gamma-ray spectrometers is discussed.

37570 **Implementation of the pulse injection technique for dead-time and pileup corrections in gamma spectroscopy suitable for automated systems.** Proctor, A.E. (Idaho National Engineering Lab., Idaho Falls, USA). *Nuclear Instruments and Methods in Physics Research;* **256**: No. 2, 355-360(1 May 1987). Contract AC07-76ID01570.

A convenient method of injecting reference pulses into a gamma ray spectrum is described. The method utilizes an injection rate which is proportional to the gross gamma count rate; the circuit described automatically adjusts the pulse injection rate as the gross count rate changes. The method has been successfully tested using a wide dynamic range spectroscopy system. This injection technique has been installed in an automated scanning system designed for unattended operation. Good results have been obtained for measurement of hundreds of spectra having wide gross count rate variations.

37571 **Accurate 2 dimensional drift tube readout using time division and vernier pads.** Green, D.; Haggerty, H.; Hansen, S.; Takasaki, M. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Instruments and Methods in Physics Research;* **256**: No. 2, 305-312(1 May 1987).

A proportional drift tube (PDT) of length l=6 m containing only two potentials for a 5 cm drift distance has been constructed. The coordinate along the drift direction is obtained conventionally. The second coordinate is obtained with an accuracy of +-0.8 mm (rms) by utilizing a combination of time division [1] and vernier pads [2], of length L=20 cm. The left/right drift time ambiguity can be resolved using separate top and bottom vernier pad readout.

37572 **Radiation dosimetry through spectral definition.** Dowdy, E.J.; Moss, C.E.; Robba, A.A.; Evans, A.E.; Lucas, M.C.; Shunk, E.R.; Goulding, C.A. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **255**: No. 1/2, 317-325(15 Mar 1987). (CONF-850925—).

From 3. international symposium on radiation physics; Ferrara, Italy (30 Sep 1985).

We have developed a fieldable instrumentation system for determining from measured flux spectra, both the neutron and gamma ray dose rate distributions associated with radioactive sources. This system includes the sensors, the computer-based data acquisition and analysis hardware, and the requisite software for unfolding the sensor response functions to obtain the flux spectra, and for folding the resultant flux spectra with appropriate flux spectrum-to-dose conversion factors. We use bismuth germanate scintillators that have experimentally measured and analytically interpolated response functions to determine the gamma ray flux spectra, and a suite of neutron sensors, based on proton recoil and $^3$He capture, to determine the neutron flux spectra. In addition, gamma ray peak identification is done using HPGe sensors. We describe the equipment and procedures and present some recent results.

37573 **Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics.** Conti, M.; Del Guerra, A.; Schwartz, G.; Habel, R.; Mulera, T.; Perez-Mendez, V. (Pisa Univ., Italy; Istituto Nazionale di Fisica Nucleare, Pisa, Italy; ENEA, Frascati, Italy; Lawrence Berkeley Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **255**: No. 1/2, 207-212(15 Mar 1987). (CONF-850925—).

From 3. international symposium on radiation physics; Ferrara, Italy (30 Sep 1985).

Also published as report LBL—20491; CONF—850925-3.

We describe the principle of operation of a high density projection chamber, in which the converter/radiator and drift field shaping structures are combined in the form of high density (5-6 g/cm$^3$) lead glass tubing. The main applications of this type of detector to medical physics (positron emission tomography) and high energy physics (electromagnetic calorimetry) are discussed.

37574 **A primer on detectors in high luminosity environment.** Huson, R.; Lederman, L.M.; Schwitters, R. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 361-368 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The following remarks are relevant to the problem of balancing luminosity versus energy in new HEP construction. In a previous study, it was stated that the only experiment that would succeed at a luminosity of 10/sup 33/cm/sup -2/sec/sup -1/ was one in which the apparatus was shielded from the collision region by massive quantity of steel. In 1981, this opinion was confirmed by an authority in the field. It may be instructive to review the progress of collider detectors over the past decade. In 1973, the time resolution or, better, the integrating time of tracking detectors was —100 ns. In 1982, this time has remained the same since PWC's are still the fastest tracking devices available. The fundamental limit is the saturated drift velocity of electrons in gases. Better resolution and three dimensional properties have led to the choice of drift chambers and TPC's which have considerably longer integration times. A new characteristic of 1982 detectors is the increasing pervasiveness of calorimeters which have become indispensable devices for measurement of electromagnetic and hadronic energy, especially at momenta where magnetic measurements become imprecise. Calorimeters, because of their innate geometric dimensions set by the nuclear mean free path and their distance from the interaction point have integration times of —200-1000 ns. Of course this is the present state of the art which depends on the properties of BBQ, gas chambers, liquid argon, lead glass, etc.

37575 **Electrodeless drift chambers with 50-CM drift distance.** Ayres, D.S.; Price, L.E. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). pp 388-390 of Proceedings of the 1982 DPF summer study on elementary particle physics and future facilities. Donaldson, R.; Gustafson, R.; Paige, F. Washington, DC; National Science Foundation (1982). (CONF-8206116—).

From DPF summer study on elementary particle physics and future facilities (APS); Aspen, CO, USA (28 Jun 1982).

The electrodeless drift-chamber technique is potentially very useful in applications requiring the drifting of ionization in gas over long distances in narrow channels. Chamber construction is simple and cheap; the technique is well suited to very large detectors operating in low-rate environments. Prototype tests on planar chambers reveal excellent drifting characteristics after the initial charging, but show a substantial degradation of pulse height from cosmic rays over a two-week period. The loss of efficiency appears to be caused by excess charge buildup on the dielectric surfaces of the chamber. Several solutions are suggested.

### 4403 Miscellaneous Instruments

*REFER ALSO TO CITATION(S) 37467, 37510, 37707, 37957, 38411*

37576 **(AERE-R—10812-Rev.) The Harwell oxygen sensors: Description, operating conditions and performance.** Asher, R.C.; Taylor, R.G. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Aug 1986. 21p. (HL—86-1377-C-8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900761.

This report describes the oxygen sensors and associated equipment developed at Harwell over the last ten years. Three types of oxygen sensor (Mk IIA, IIB, and III) are described and the aspects covered include ceramic thimble manufacture, inspection procedures, calibration facilities, housing, installation, operating conditions and sensor performance.

37577 **(CONF-8704112—6) Development of the NBS $^{10}Be/^{9}Be$ isotopic standard reference material.** Inn, K.G.W.; Raman, S.; Coursey, B.M.; Fassett, J.D.; Walker, R.L. (National Bureau of Standards, Washington, DC (USA); Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010599.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

The National Bureau of Standards (NBS), in conjunction with the Oak Ridge National Laboratory (ORNL) and the Accelerator Mass Spectrometry (AMS) community, is in the process of developing a $^{10}Be/^{9}Be$ isotopic solution Standard Reference Material (SRM). The starting $^{10}Be/^{9}Be$ solution was provided by the ORNL after Secondary Ionization Mass Spectrometric characterization for isotopic concentration. The radioactivity purity of the ORNL Master solution was confirmed by gamma-ray spectrometry, then diluted at NBS with solutions made from zone-refined single-crystal beryllium metal and sub-boiling double-distilled hydrochloric acid. Four serial dilutions were necessary to achieve a final $^{10}Be/^{9}Be$ isotopic composition of approximately $3 \times 10^{-11}$ (g/g). The accuracy of the dilutions was confirmed by liquid scintillation and AMS measurements. The isotopic composition of the ORNL Master solution was also confirmed at NBS by Resonant Ionization Mass Spectrometry. The isotopic composition of the final solution is being affirmed at the present time through international laboratory AMS measurements.

37578 **(SAND—86-0236) A device to measure friction coefficients and contact resistance inside a scanning Auger microscope.** McDonald, T.G.; Peebles, H.C.; Peebles, D.E.; Pope, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010992.

A device is described for in situ, rotary pin-on-disk wear studies in a commercial scanning Auger microscope. This device is mounted on a single eight-inch vacuum flange and can be installed in place of the normal sample mounting manipulator. The device allows simultaneous measurement of contact resistance and friction coefficient under controlled atmospheric conditions as wear progresses. The surface composition and topography of the wear track are measured without exposure of the surface to contaminating environments or removal of the pin from the wear track. Modifications made to the vacuum system to facilitate atmospheric control are also described.

37579 **(SAND—86-1606C) Characterization of accelerometer mountings in shock environments.** Bateman, V.I.; Solomon, O.M. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-870755—1). NTIS, PC A02. File Number DE87009295.

From 14. transducer workshop; Colorado Springs, CO, USA (16 Jul 1987).

This report describes the shock test characterization of four accelerometer mounting techniques which are: adiprene and wax, polysulfide rubber and wax, restrained adiprene, and hard mount. The mountings have all been used in field tests, and the shock testing provides some simulation of the field test environments. The characteristics of these mountings are analyzed in the time-domain and in the frequency-domain and are compared to the response of a reference accelerometer at two different shock levels, approximately 2 kg and 7 kg. While soft mounting techniques can be used to guarantee accelerometer survival in severe mechanical environments, this report documents the tested mounting materials to be highly nonlinear. These nonlinearities result in signifcant data distortion at frequencies above a few hundred hertz.

## 45 EXPLOSIONS AND EXPLOSIVES

### 4501 Chemical

*REFER ALSO TO CITATION(S) 37383, 37706, 38015*

37580 **(AD-A—179272/0/XAB) System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1.** Orr, R.S. (Stanford Telecommunications, Inc., Reston, VA (USA)). 10 Apr 1987. 74p. (STI/E-TR—860135). NTIS, PC A04/MF A01.

Nuclear-event-induced atmospheric scintillation can have an adverse effect on communication systems of all types. Satellite communication systems are particularly susceptible to channel disruption resulting from atmospheric scintillation. This report documents the preliminary results of an effort to develop a tool to assist communication system designers. Various simulation and models attempt to characterize the dynamics of a nuclear perturbed atmosphere. The report focuses on resolving apparent differences of primary interest to the context of radio frequency phase relationships are addressed relative to a number of commonly used transmission schemes.

37581 **(LA—10874) The shell model for hot-spot ignition.** Partom, Y. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012050.

The properties of the viscoplastic pore-collapse model, also known as the shell model, are investigated to see whether viscoplastic heating at the pore boundary can be regarded as a hot-spot ignition mechanism for the surface-burn growth process. To this end, we modify the usual viscoplastic pore-collapse equations by including the effects of bounded viscoplastic strain rate, chemical reaction at the pore boundary, consumption of the boundary by the chemical reaction, and build-up of pore-gas pressure and temperature. We conclude that viscoplastic pore collapse creates the necessary conditions for ignition and is insensitive to the parameters so that it can indeed be regarded as an efficient hot-spot ignition mechanism.

37582 **(LA-UR—87-1964) Hot-spot reaction in unsustained shocks.** Johnson, J.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—12). NTIS, PC A02. File Number DE87011781.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Shock waves in reactive media create hot spots which undergo further temperature change (following creation) by means of (1) chemical reaction, (2) thermal conduction, and (3) adiabatic effects resulting from pressure variation. A thermodynamic description of exothermic reaction under conditions of variable pressure is presented here. The reaction rate is assumed to be a function of temperature only, and of the Arrhenius form: the effect of variable pressure enters through its influence on temperature. Decreasing pressure significantly alters adiabatic thermal explosion times, and can, under nominal conditions, completely inhibit hot-spot reaction. This effect is discussed in terms of explosive initiation by unsustained shock waves. 7 refs., 2 figs.

37583 **(MLM—3442(OP)) The application of variable explosive chamber testing to actuator testing.** Munger, A.C. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 17p. (CONF-870668—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011840.

From 3. international conference of the Groupe de Travail de Pyrotechnic Spatiale and 12. international pyrotechnics seminar; Paris, France (8 Jun 1987).

The Variable Explosive Chamber (VEC) test setup has been used for research, design, and quality control of pyrotechnic actuators. The test was devised by Sandia National Laboratories, Livermore. The results obtained during component development are covered in this report, along with fault analysis of the test device. The data from components at various powder densities and pyrotehnic masses are shown. The effects of test hardware design, such as press fits or sliding fits, are shown. The effects of test hardware design, such as press fits or sliding fits, are shown. The hardware used by Mound was fabricated by a specialty vendor and is no longer available. Therefore, a new test design is presented, along with preliminary data that correlate the two test designs. 3 refs., 15 figs.

37584 **(UCRL—15902) Demilitarization of conventional ordnance: Priorities for data-base assessments of environmental contaminants.** Layton, D.W.; McKone, T.E.; Hall, C.H.; Nelson, M.A.; Ricker, Y.E. (Lawrence Livermore National Lab., CA (USA)). Feb 1986. Contract W-7405-ENG-48. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011329.

The primary goal of this study has been to identify a set of environmental by-products from the demilitarization of conventional ordnance that should be the subject of more detailed data-base assessments. In order to rank the by-products according to their potential health risks, estimates were made of the contaminant releases associated with destructive techniques (e.g., open burning, open detonation, and incineration) and nondestructive techniques (e.g., filler recovery and reuse). Estimates of the types and quantities of propellants, explosives, and pyrotechnics in the demilitarization inventories of various installations in the US were made. To calculate hypothetical doses to man from contaminant releases, a multimedia compartmental model was used to calculate the concentrations of contaminants in water, soils, air, and biota. Based on an analysis of the doses and toxicity data for the compounds, several substances were recommended for further analysis, including DNT, TNT, and RDX and their degradation products in the environment. Other compounds are dibutyl phthalate, diphenylamine, HMX, and tetryl.

37585 **(UCRL—94049) Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring.** Leider, H.R.; Pane, A.J. (Lawrence Livermore National Lab., CA (USA)). May 1986. Contract W-7405-ENG-48. 20p. (CONF-8605268—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009602.

From JOWOG-12 meeting; Golden, CO, USA (12 May 1986).

Nitrate esters on the $C_2$, $C_3$ and $C_6$ positions on the anhydrogluclose units of cellulose nitrate (NC) can be distinguished using high resolution Fourier transform nuclear magnetic measurements of $^{13}C$. Changes in the ester population after thermal aging of NC indicate that the three ester positions have different thermal stabilities. Some trends are discussed. 9 refs., 10 figs., 3 tabs.

## 4502 Nuclear

*REFER ALSO TO CITATION(S) 36558, 36771*

37586 **(AD-A—179070/8/XAB) Computer fallout code using variable winds for operational-type studies. Master's thesis.** Strines, A.B. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1987. 157p. (AFIT/GNE/ENP—87M-7). NTIS, PC A08/MF A01.

A radioactive fallout code, HYDRA, has been developed that uses real winds to determine dose rate contours on the ground. These winds are calculated from spectral coefficients derived by the National Meteorological Center. HYDRA models the radioactive dust cloud as a set of pancake clouds, each cloud representing a different particle-size group. Each particle size group is transported to the ground through a discretely layered atmosphere using McDonald-Davies fall mechanics. Dose-rate contours are determined by smearing the cloud activity along the ground as the cloud descends. HYDRA was evaluated against another variable wind fallout code named REDRAM. The two codes produced identical hotlines. HYDRA is capable of overlaying dose rate contours on global maps through the use of DISSPLA software. A copy of the HYDRA source code is included in the report.

37587 **(AD-A—179114/4/XAB) Particle-size determination from local fallout. Master's thesis.** Davis, N.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 80p. (AFIT/GNE/ENP—86D-1). NTIS, PC A05/MF A01.

The purpose of this research was to examine isodose-rate contours and cloud-arrival-time data from atmospheric nuclear tests conducted at the Nevada Test Site to validate size distributions currently used in fallout prediction models or to propose new size distributions. Results were obtained from studies of eight air, nine tower, two surface and two shallow subsurface bursts. Yields ranged from 0.3 to 74 kilotons and heights of burst ranged from -67 to 1500 feet. The tests examined are tabulated in Appendix A. Isodose rate contours from U.S. atmospheric nuclear tests (9) were digitized and then integrated numerically to obtain information on the fraction of activity grounded with time. The parameters of the best-fit lognormal and best-fit power-law particle-size distributions were then found for each burst studied. There was insufficient fallout from tower and air bursts to make conclusive determinations about the size distributions produced by these classes of bursts. For surface and shallow subsurface bursts the debris may be characterized by a lognormal distribution, by a power-law r to the -n power distribution, or by a linear combination of these or possibly other distribution functions. While no definitive distribution function was established, a linear combination of lognormal distributions seems to hold the most promise. In addition, a lower bound of 2210 r-sq. mi/hr-kt was established for the source normalization constant.

37588 **(AD-A—179416/3/XAB) Command and control of the US heavy division on the nuclear battlefield.** Rowe, R.J. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies). 5 Dec 1986. 57p. NTISMF A01.

Availability: Microfiche copies only.

This monograph examines the ability of the Army of Excellence heavy division's command and control function to support tactical operations on the nuclear battlefield envisioned in AirLand Battle Doctrine. It describes both U.S. and Soviet doctrines for tactical operations on the integrated (conventional and NBC) battlefield and implications of Soviet military doctrine for the C & C of U.S. forces. Current U.S. doctrine for the organization, process, and facilities of the heavy division's C & C function provides the basis for establishment of criteria to judge this system. The criteria involve the process (which includes the way of thinking) and the physical structure. Consideration of the adequacy of the heavy division's C & C function, then, occurs within the framework provided by defensive and offensive tactical situations. The study finds that preservation of the C & C system is a top priority for the heavy division and that the tenets of AirLand Battle Doctrine point the direction for strengthening the current system. Although the decentralized C & C method Auftragstaktik appears to be a strength of the system, overall the heavy division falls short in its capability to provide an assured capacity for performance of critical tasks within a nuclear environment. Major deficiencies include a questionable ability to generate plans and mission orders during combat operations and an inadequate physical structure to provide for continuity of C & C.

37589 **(AD-A—179560/8/XAB) Tactical encirclement reductions.** Gutwald, R. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies). 5 Dec 1986. 43p. NTISMF A01.

Availability: Microfiche copies only.

This monograph discusses the intricacies of liquidating tactical encirclements and bypassed pockets of enemy resistance. Operational employment of U.S. Army doctrine will lead to tactical encirclements in most instances. Contemporary doctrine, however, fails to acknowledge the probability of encirclement. Additionally, doctrine fails to address methods of dealing with enemy pockets. History argues that encircled enemy units often refuse to capitulate and usually require reduction by force. Furthermore, four brief examples of encirclement from the Russo-German front of World War II demonstrate that reduction operations are often difficult and complex. An encircling commander must foresee the consequences of encirclements and attempt to create the most favorable conditions for the reduction of encircled enemy forces. He must select a method and technique of reduction. He must base his selection of the situation, the threat posed by the enemy, the requirement for speed, the available resources, and the likely costs. Regardless of the method and technique chosen, the encircling commander must also consider the following: pausing to organize, establishing maneuver and fire control measures, isolating the enemy, nuclear weapon employment, and psychological operations. This paper concludes that the Army must acknowledge its doctrinal void, research and develop a reduction methodology, and amend its doctrine.

37590 **(AD-A—995462/9/XAB) Operation Greenhouse. Scientific director's report of atomic weapon tests at eniwetok, 1951. Annex 9.1. Staff reports. Parts 1 to 4. Annex 9.4. Documentary photography.** (Los Alamos Scientific Lab., NM (USA)). 1951. 93p. NTIS, PC A05/MF A01.

37591 **(AD-B—090882/2/XAB) Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report.** Weitz, R.; Thomas, C.; Klemm, J.; Stuart, J.; Knowles, M. (Science Applications International Corp., McLean, VA (USA)). 3 Mar 1982. 188p. (SAI—84-1567-VOL-2). NTIS, PC A09/MF A01.

See Also Volume 3, AD—B090-883L; Distribution limitation now removed.

External radiation doses are reconstructed for crews of support and target ships of Joint Task Force One at Operation CROSSROADS, 1946. Volume I describes the reconstruction methodology, which consists of modeling the radiation environment, to include the radioactivity of lagoon water, target ships, and support ship contamination; retracing ship paths through this environment; and calculating the doses to shipboard personnel. The USS RECLAIMER, a support ship, is selected as a representative ship to demonstrate this methodology. Doses for all other ships are summarized. Volume II (Appendix A) details the results for target ship personnel. Volume III (Appendix B) details the results for support ship personnel. Calculated doses for more than 36,000 personnel aboard support ships while at Bikini range from zero to 1.7 rem. Of those, approximately 34,000 are less than 0.5 rem. From the models provided, doses due to target ship reboarding and doses accrued after departure from Bikini can be calculated, based on the individual circumstances of exposure.

37592 **(AD-B—090883/0/XAB) Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report.** Weitz, R.; Thomas, C.; Klemm, J.; Stuart, J.; Knowles, M. (Science Applications International Corp., McLean, VA (USA)). 3 Mar 1982. 452p. (SAI—84-1567-VOL-3). NTIS, PC A20/MF A01.

See Also Volume 1, AD—A152-702; Distribution limitation now removed.

External radiation doses are reconstructed for crews of support and target ships of Joint Task Force One at Operation CROSSROADS, 1946. Volume I describes the reconstruction methodology, which consists of modeling the radiation environment, to include the radioactivity of lagoon water, target ships, and support ship contamination; retracing ship paths through this environment; and calculating the doses to shipboard personnel. The USS RECLAIMER, a support ship, is selected as a representative ship to demonstrate this methodology. Doses for all other ships are summarized. Volume II (Appendix A) details the results for target ship personnel. Volume III (Appendix B) details the results for support ship personnel. Calculated doses for more than 36,000 personnel aboard support ships while at Bikini range from zero to 1.7 rem. Of those approximately 34,000 are less than 0.5 rem. From the models provided, doses due to target ship reboarding and doses accrued after departure from Bikini can be calculated, based on the individual circumstances of exposure.

37593 **(DOE/NBM—7010972) A history of the United States Atomic Energy Commission, 1952-1960: Volume 3.** Hewlett, R.G.; Holl, J.M. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Chief Historian). [1987]. 562p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87010972.

This is a detailed historical account of the activities and policies of the Atomic Energy Commission during the Eisenhower and Kennedy administrations. 6 figs. (DWL)

37594 **(LA—11059-MS) The Cliper Data Acquisition System.** Watson, C.A. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012106.

The Cliper Data Acquisition System was developed at Los Alamos National Laboratory to aid containment scientists in understanding cavity collapse after underground nuclear tests at the Nevada Test Site. It consists of menu-driven software residing on a MicroVAX I, a TK50 tape drive, and the EXCOR (EXtended COntinuous Reflectometer) hardware unit developed by EG & G. The system was developed to provide a profile of downhole cable lengths during cavity collapse. This report will discuss the methods by which data are obtained, the EXCOR capabilities and pertinent EXCOR parameters for controlling the data acquisition cycle, and the operation of the CLIPDAT program that communicates with EXCOR and provides data output listings.

37595 **(PB—87-184644/XAB) Case for strategic defense: an option for a world disarmed.** Keyworth, G.A. (Office of Science and Technology Policy, Washington, DC (USA)). 1984. 19p. NTIS, PC A02/MF A01.

Pub. in Issues in Science and Technology, Vol. 1, No. 1, 30-44(1984).

The report provides an option for a world effectively disarmed of nuclear weapons yet still retaining national sovereignty and security.

37596 **(SAND—87-0283C) Vault demonstration program.** Scott, S.H. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870890—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010738.

From 3. annual Armed Forces Communications Electronics Association and exposition; Philadelphia, PA, USA (4 Aug 1987).

There is a continuing expansion of the threats that must be countered at weapon storage areas with respect to both the security and survivability of the stored weapons. These threats will continue to evolve into the 21st century. One approach to counter these threats is to increase the storage hardness for the stored materials. The goal of this program, which is sponsored and funded by the Defense Nuclear Agency, is to demonstrate near-surface vault storage for a variety of stored materials. Two vault designs are being demonstrated as part of the program. A full feature vault incorporates many features to enhance the vault operational capabilities. These include a self-contained internal lift, a back-up drive system, flexible interior storage, and sensors with alarm status reporting. The Simplified Storage Vault (SSV) eliminates many of these features to reduce to a minimum the installed cost of vault storage. Features to enhance the survivability hardness of stored materials are incorporated into both vault designs. The full feature vault installation is complete and is undergoing engineering test and evaluation. The SSV installation is to be completed in August 1987. Both vault designs and evaluation results to date are described. 3 refs., 5 figs.

## 4503 Explosion Detection

37597 **(AD-A—179377/7/XAB) Technical report for the period 1 October-31 December 1986.** (Science Applications International Corp., Arlington, VA (USA). Center for Seismic Studies). Feb 1987. 118p. (SAIC—87/1584). NTIS, PC A06/MF A01.

Work on network design and capability assessment focused on defining the seismological criteria for selecting stations of a global seismic network to achieve a specified minimum verification capability. The design criteria are defined with a view toward minimizing the gap between seismic-detection threshold and the threshold for recording seismic waves used for discriminating earthquakes from nuclear explosions. Research to improve analysis of regional seismic data is currently focused on determining various waveform signatures of events that occur frequently at the same location. Examples being studied include repeated explosions at mines in the western USSR and Scandinavia, presumed underwater detonations off the coast of Norway, and northern European earthquake sequences. Procedures being tested as seismic signature elements include the formation of particle-motion parameters from the six terms of the three-component covariance matrix, plus spectral and autoregressive analyses. A review of evidence for high-quality propagation of seismic waves at regional distance ranges in the USSR was conducted. The available data are consistent with maximum Q/sub a/ of about 2000 for regional seismic waves. In both the Baltic shield and central Asia, high-frequency signals from small events are observed to about 500-600 km, but disappear into the noise at larger distance ranges.

# 50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

*REFER ALSO TO CITATION(S) 37859*

## 5001 Basic Studies

*REFER ALSO TO CITATION(S) 37498*

37598 **(NP—7770135) Comparison between four different interregional air pollution models. Appendix 1.** Klug, W.; Glaab, H.; Goemer, D.; Roeckle, R.; Builtjes, P.J.H.; Hout, K.D. v.d.; Veldt, C.; Dop, H. van; Haan, B.J. de; Egmond, N.D. van. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Meteorologie; Umweltbundesamt, Berlin (Germany, F.R.); Nijverheidsorganisatie TNO, Apeldoorn (Netherlands); Koninklijk Nederlands Meteorologisch Inst., De Bilt). Mar 1984. 149p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87770135.

The results of short term air pollution models have been compared considering also observed immission data. For the comparison of the short term models data sets for three different episodes in 1979, 1980 and 1981 were used. The aim of the work was to study the performance of air pollution models. With 38 refs., 21 tabs., 59 figs.

## 5002 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 36275, 36286, 36321, 36326, 36329, 36330, 36332, 36337, 36480, 36606, 36607, 36760, 36763, 36764, 36765, 36967, 36968, 37084, 37085, 37086, 37088, 37090, 37092, 37094, 37157, 37158, 37184, 37403, 37522, 37525, 37526, 37584, 37598, 37783, 37787, 37795, 37796, 37798, 37799, 37806, 37810, 37843, 37888, 37889, 37939, 37942, 37943, 37944, 37945, 37947, 37948, 37949, 37950, 37951, 37953, 37958, 37988, 37989, 37990, 37993, 37994, 37996, 37999, 38003, 38004, 38018*

37599 **(AD-A—179286/0/XAB) Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report).** Segal, H.M. (Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy). Apr 1987. 42p. (FAA-EE—86-11-A-REV-1). NTIS, PC A07/MF A01.

Revision 1 to report dated Dec 1986; Availability: Document partially illegible.

The air-quality impact of the proposed runaway expansion program at Stapleton International Airport is determined in this report. The method of analysis is to model the dispersion of pollutants from motor vehicles and aircraft under both 1-hour and 8-hour worst-case conditions. Results show that aircraft pollution concentrations are reduced and, in some cases, completely disappear when the new runaways are added. This is caused primarily by a reduction in takeoff delays, which are a major objective of the runaway-expansion programs at the report.

37600 **(BNL—39457) Two-zone modelling for air exchange rates and $NO_2$ source and decay rates in a Southern California residential indoor air quality study.** Hoogendyk, C.G.; Dietz, R.N.; D'Ottavio, T.W.; Goodrich, R.W. (Brookhaven National Lab., Upton, NY (USA)). Feb 1987. Contract AC02-76CH00016. 6p. (CONF-870853—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008203.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

BNL/AIMS and $NO_2$ measurements were applied to 640 homes in Southern California during March 1984, July 1984, and January 1985. Whole house AERs had median values of 0.84/h, 1.5/h and 0.55/h respectively. $NO_2$ decay rates for 18 all-electric homes, and for the bedroom zone across all homes, had a median of about 0.6/h and did not vary noticeably among test periods. Median $NO_2$ source rates for the living zone (kitchen and living room) were 10.6 mg/h, 12.3 mg/h and 7.4 mg/h, while medians for the bedroom zone were all 0 mg/h. Outdoor sources made the largest contribution to $NO_2$ in the bedroom zone, while indoor sources were marginally more important than outdoor in the living zone (Southern California has high concentrations of outdoor $NO_2$).

37601 (CONF-8508235—, pp 247-249) **Combination of different methods of surveying and analysing forest decline to create a basis to investigate the causes, as practised in West-Berlin.** Lakenberg, E. (Landesforstamt, Berlin, Germany, F.R.). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

This is a very concise report describing, by way of example, the methodic concept used in West-Berlin in the attempt of controlling the course of forest decline and elucidating the relationships behind, and causes of, the disease. To that end, a combination of representative surveys with intensive analyses in selected objects is deemed necessary. Care must be taken to assure that results are comparable with those of other regions. This requires in part rather complicated mutual adjustment of the analysing methods, even regarding details.

37602 (CONF-8608141—, pp 417-421) **Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland).** Kontic, R.; Niederer, M.; Nippel, C.; Winkler-Seifert, A. (Institute of Botany, Univ., Basal, Switzerland). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Abrupt growth reduction and recovery in tree stems are the result of environmental influences. A very simple method is used to date such events in some 3000 cores from pines (Pinus silvestris L.), firs (Abies alba Mill.), and spruces (Picea abies (L.) Karst.) growing in the Swiss Rhone Valley (the Valais). Reconstruction of the history of forest damage and investigation of its geographical distribution allow examination of various hypotheses as to the cause of damage. The pollution stress theory seems to be the only plausible explanation for the extensive damage and is substantiated by various findings. 1 reference, 3 figures.

37603 (CONF-8608141—, pp 475-484) **Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide.** D'Arrigo, R.; Jacoby, G.C.; Fung, I.Y. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In this study, the role of boreal forests in atmosphere-land biosphere $CO_2$ exchange was investigated using analyses of climatically-sensitive tree ring chronologies from boreal treeline sites in conjunction with high latitude $CO_2$ measurements, global satellite vegetation data (NDVI) and a 3D atmospheric tracer transport model.

37604 (CONF-8608141—, pp 485-493) **Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$.** Long, A.; Leavitt, S.W.; Cheng, S. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The authors have measure stable carbon isotope values in tree-ring cellulose systematically sampled from the highest and lowest altitude bristlecone pine trees in the White Mountains of eastern California. In both sample sets the C-13/C-12 responds to changes in the C-13/C-12 in atmospheric carbon dioxide. Long-term C-13/C-12 trends appear to vary inversely with past atmospheric carbon dioxide concentrations measured in Antarctic ice. Similar long-term trends between C-13/C-12 in tree-ring cellulose and ring-width indices suggest that carbon dioxide partial pressure affects the growth rate at the high altitude trees where its partial pressure is lowest. Calculations based on physiologic equations are also consistent with fertilization. Shorter term variations in C-13/C-12 in tree-ring cellulose evidently have complex explanations probably not related to carbon dioxide concentration variations. 22 references, 1 figure, 1 table.

37605 (CONF-8704155—1) **Effects of ozone on forests in the northeastern United States.** Adams, M.B.; Taylor, G.E. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010887.

From Ozone risk communication conference; Amherst, MA, USA (21 Apr 1987).

Methodologies for characterizing $O_3$ air quality are reviewed, with particular reference to forests in the northeastern United States. It is proposed that analyses be more ecologically and physiologically based. In particular, exposure statistics are recommended that (1) capture the temporal and spatial characteristics of $O_3$ air quality, (2) incorporate an understanding of the ecological properties of the pollutant and the physiological sensitivity of forest trees, and (3) recognize the pollutant's unique chemical attributes that make it distinct from other pollutants. With respect to forest ecosystems in the Northeast, the most distinctive feature of $O_3$ air quality is the dynamics of episodically high $O_3$ concentrations during the growing season. $O_3$ concentrations of 50 ppB or greater for a 28-day exposure period were found to affect growth and yield of sensitive forest species. However, the majority of species require substantially longer exposure or higher concentrations before growth reductions occur. In mixed stands, the most probable effects of $O_3$ stress will be subtle, long-term shifts in species composition, due to impacts on sensitive individuals or species.

37606 (DOE/PC/73226—4) **Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987.** Winnick, J. (Georgia Inst. of Tech., Atlanta (USA). Dept. of Chemical Engineering). 14 Apr 1987. Contract FG22-84PC73226. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87008308.

Development of an electrochemical process to remove SO/sub x/ and NO/sub x/ from flue gas is reported. Here, we point out the major developments and outline the direction future research will take to progress toward a novel, economic flue gas clean-up process.

37607 (ENEA-RT/FARE—86-8) **Environmental effects due to the use of conventional and innovating fuels for autotraction.** Avella, R.; Dominici, F.; Martino, C. (ENEA, Rome (Italy)). Sep 1986. 190p. (In Italian). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752627.

The aim of the present study is to discuss the problems of the environmental impact due to the use of either gasoline, blended or not with octane boosters, mixtures of alcohol-gasoline, ethanol, gaseous fuels and Diesel oils as fuels for vehicles. In the first section, the different actions of scientific-cognitive or legislative nature, which have been undertaken up till now at EEC level or at national level, are illustrated. Then the principle pollutants produced by the combustion of the different fuels are appraised. The relative contribution to the atmospheric pollution by the transport sector and the specific factors of the pollutants generated by it is quantified also. At last the various hypotheses for the use of new fuels for vehicles and for the substitution of actual high-octane additives are evaluated.

37608 (ENV-MER—80-053) **Study of fog formation and developments on the industrial plants at Lacq (France). Role of condensation nuclei.** Gorbinet, G. (Ministere de la Qualite de la Vie, 75 - Paris (France)). Apr 1983. 186p. (In French). NTIS (US Sales Only), PC A09. File Number DE87752316.

The influence of release of industrial effluents (water vapor, SO/sub 2/, NO/sub /x...) on fog formation and growth. Fogs occur for given meteorological conditions which are not always easy to precise. Formation and evolution of fogs are more complex on a site with important release of gaseous effluents. Condensation nuclei in these effluents or produced by physicochemical reactions play an important part in radiative balance and in fog generation and stabilization mechanisms.

37609 (EPRI-CS—5198-Vol.2) **Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report.** Nicholson, J.K.; Nelson, M.D. (Southern Electric International, Birmingham, AL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 253p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920492.

A general guideline document for the operation and maintenance of electrostatic precipitators in the electric utility industry was written as part of the EPRI Project Electrostatic Precipitator Guidelines (RP-2243-1). The document summarizes the available literature on the subject of precipitator operation and maintenance and presents the information in a format useful to plant personnel responsible for the care of precipitators.

37610 (EPRI-CS—5198-Vol.3) **Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report.** DuBard, J.L.; Nichols, G.B. (Southern Research Inst., Birmingham, AL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 336p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920493.

A general guideline document for troubleshooting electrostatic precipitators in the electric utility industry was written as part of the EPRI Project Electrostatic Precipitator Guidelines (RP-2243-1). The document discusses investigative techniques used in precipitator troubleshooting and offers procedures for problem resolution. It is written in a format useful to those plant personnel who are responsible for the care of precipitators.

37611 (IEA/ICEAS/B—4) **Flue gas desulphurisation: system performance.** Dacey, P.W.; Cope, D.R. (International Energy Agency Coal Research, London (UK)). Dec 1986. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number TI87900844.

This report is the first part of a two-part study of flue gas desulphurization (FGD) technologies in coal-fired combustion facilities. This part is concerned with the performance characteristics and experiences of existing FGD systems.

37612 (LMF—115, pp 9-13) **Design criteria of a virtual impactor.** Chen, B.T.; Yeh, H.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Important design parameters which influence wall losses and separation characteristics of a virtual impactor have been experimentally identified. The authors found that an optimal throat length (t) of the probe opening was required to obtain good separation characteristics. Also, design parameters around the particle separa-

tion zone such as the diameter ($D_2$) of the top surface of the probe, the radius (R) of the rounded shoulder of the probe opening, and the diameter ($W_1$) of the lower surface of the nozzle should be carefully selected to reduce internal losses. Based on these results, they have designed and evaluated an improved virtual impactor which has small wall losses (< 5%) and little or no fine particle contamination. Both solid and liquid aerosols were studied and good agreement in results was obtained. 2 references, 4 figures, 1 table.

37613 (LMF—115, pp 25-30) **Drag force and slip correction factor of aggregates measured in a Millikan apparatus.** Cheng, Y.S.; Allen, M.D.; Gallegos, D.G.; Yeh, H.C.; Peterson, K. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Drag force on aggregate particles of uniform spheres were measured in a Millikan apparatus as a function of Knudsen number. To determine the effect of particle orientation on the slip correction of nonspherical particles, the authors performed the measurement in the following manner. Movement of charged particles in gravity with and without an applied electrical field was measured. An electrical field strength of 2000 V/cm was used to align doublet and triplet particles. Their results showed that an aggregate particle moved with random orientation in the gravitational field. The same particle moved with its axis of symmetry parallel to the electrical field (doublets) or perpendicular to the electrical filed (triangular triplets). Using a nonlinear regression method, the authors determined the dynamic shape factor and slip correction factor separately from the data. The dynamic shape factors at different orientations were in good agreement with those obtained in the sedimentation tank. The slip correction factor of singlet particles agreed with results obtained by Allen and Raabe for latex particles. Slip correction factors of doublets and triangular triplets also followed the Kundsen-Weber form: 1 + 2 λ/d/sub a/[1.142 + 0.558 exp(-0.999 d/sub a/2λ)], where λ is the mean free path of the gas and d/sub a/ is the adjusted sphere diameter, 2 references, 5 figures, 1 table.

37614 (LMF—115, pp 31-34) **Cigarette smoke aerosol in a Walton smoke machine.** Chen, B.T.; Namenyi, J.; Yeh, H.C.; Mauderly, J.L. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Mainstream cigarette smoke from the exposure chamber of a Walton smoking machine was characterized. Using cascade impactors, the mass median aerodynamic diameter and geometric standard deviation of the particle size distribution were found to be 0.54-0.59 μm and 1.3-1.4, respectively. A correction for coagulation resulted in a smaller mass median aerodynamic diameter (0.47-0.53 μm). Total particulate matter (TPM) was determined to be 3.3-3.6 mg/puff/cigarette using filter samples. Results for TPM and size distribution are in good agreement with those obtained by other investigators. 7 references, 2 figures, 2 tables.

37615 (LMF—115, pp 35-38) **Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys.** Hoover, M.D.; Finch, G.L.; Mewhinney, J.A.; Eidson, A.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Typical particles that might be inhaled by beryllium workers were evaluated during the use of standard machining methods to saw and mill billets of beryllium metal, beryllium copper alloy, and beryllium nickel alloy. Concentrations of airborne beryllium in the workplace were less than 2 mg/m$^3$, but the peak concentrations in the ventilation shrouds were greater than 5 mg/m$^3$. The rate of aerosol production was highest when using beryllium metal, and was more than a factor of 10 lower when using copper and nickel alloys. All particles were irregular in shape and had projected area diameters extending down to the micrometer range. 7 references, 1 figure, 2 tables.

37616 (LMF—115, pp 39-42) **Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization.** Hoover, M.D.; Finch, G.L.; Blonigen, S.J.; Mewhinney, J.A.; Eidson, A.F.; Rothenberg, S.J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

A pulsed Nd:YAG laser was used to aerosolize material from the surface of a rotating beryllium metal rod. Aerosols of branched chain ultrafine particles were formed. Particles formed in an ultrapure argon atmosphere were beryllium metal, with only 3% mole fraction converted to BeO. Particles formed in an air atmosphere were 100% beryllium oxide. Primary particles were spherical for the metal aerosol and hexagonal crystals for the oxide aerosol. Primary particle size was 0.05 μm for the metal aerosol and 0.04 μm for the oxide aerosol. Specific surface areas in m$^2$/g were 62.1 +/- 0.8 for the metal aerosol and 47.8 +/- 1.4 for the oxide aerosol. In vitro dissolution in serum ultrafiltrate was negligible for both aerosols and dissolution in HCl showed the oxide particles to be less soluble than the metal particles. 4 references, 2 figures, 2 tables.

37617 (LMF—115, pp 43-47) **Beryllium particle density measurements using isopycnic density gradient centrifugation.** Finch, G.L.; Hoover, M.D.; Mewhinney, J.A.; Eidson, A.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The physical densities of very small quantities (a milligram or less) of respirable-sized beryllium oxide and beryllium metal particles were measured using a density-gradient centrifugation technique. Thallium formate solutions were centrifuged to form reproducible density gradients. All aerosols tested were found to be essentially monodense. The density of beryllium metal particles was found to be 1.84 g/cm$^3$. Beryllium oxide aerosols were observed to have densities between 2.59 and 2.92 g/cm$^3$ depending on their method of production. This work demonstrates the utility of this technique for characterizing small quantities of aerosols with densities between 1.85 and 3.0 g/cm$^3$. 4 references, 4 figures, 1 table.

37618 (LMF—115, pp 69-74) **Comparison of indoor dust samples collected in different environments.** Rothenberg, S.J.; Pickrell, J.A.; Hobbs, C.H. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The characterization of the adsorption properties of indoor dusts will assist the authors understanding of gas-particle dynamics in the indoor environment. Samples of indoor dust collected in different homes, and in the same home in different years, were studied by thermogravimetric analysis (TGA) in argon and oxygen and by determination of nitrogen adsorption curves. TGA results demonstrated marked differences in the residues left after analysis of samples from different homes. In most cases, the differences between samples from the same home were small. In one case, samples collected from two different rooms in the same home showed quite different shapes of oxidative TGA curve indicating different amounts of combustible material in the samples. The range of specific surface areas found was quite small. Since no marked differences in adsorption properties of different samples were observed, it is probable that most indoor dusts retain adsorbed vapors for hours or days, as previously demonstrated for a small number of samples. 10 references, 1 figure, 2 tables.

37619 (LMF—115, pp 75-79) **Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University.** Yeh, H.C.; Newton, G.J.; Henderson, T.R.; Hobbs, C.H. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

This report describes preliminary field sampling results on the fluidized bed combustor (FBC) at the East Stroudsburg State University during its normal operation for supplying heat and hot water to the campus. Emphasis was placed on characterization of

process stream effluents including particles and vapor-phase organic constituents. Preliminary results indicate that the loading of particulate matter is similar to other FBCs the authors have sampled. The vapor-phase organic contents indicate that the quantities of individual polycyclic aromatic hydrocarbons (PAHs) are low, being less than 2.5 $\mu g/m^3$ for any individual sample. Most of the PAHs detected are low boiling compounds such as naphthalene or phenanthrene with trace amounts of pyrene. 4 references, 1 figure, 4 tables.

37620 (LMF—115, pp 397-400) **Use of risk assessment methods in the certification of decontamination buildings.** Seiler, F.A.; Davis, H.T.; Kominsky, J.R.; Ronan, R.J.; Kwoka, C.D. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Accidental events such as fires, explosions and leaks may result in large-scale contaminations of buildings. After decontamination, certification for original use requires testing for residual contamination. The two sampling plans in use up until recently both fall short of the required performance. A new kind of sampling strategy is proposed and discussed. Motivated by concern for the long-term safety of the building's occupants, it is based on factors important in risk assessment. Different sampling plans are derived in the framework in this methodology, two of which have already been used in actual certification proceedings. 3 references, 2 tables.

37621 (NILU-F—18/84) **Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation.** Iversen, T. (Norsk Inst. for Luftforskning, Lillestroem). Jun 1984. 14p. (In Norwegian). (CONF-8406360—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752500.

From 14. Nordic meteorologist meeting; Tromsoe, Norway (25 Jun 1984).

The report deals with the Arctic pollution and points out that such pollution exists and is quite significant. Some properties and some of the components are mentioned. Since the Arctic has few local pollution sources, those types that exist, must be airborne. The major geographic sources are pointed out as well as meteorological phenomena which contribute to the air flow and pollution distribution pattern in the area. Some examples of the types of pollution and their distribution are outlined. The pollution in the area are of meteorological interest. The amount of chemical components which are radiation active in infrared radiation and aerosols may alter the area into a climatological marginal area. 12 references.

37622 (NIVA-O—82073) **RAIN project. Annual report for 1984.** Wright, R.F. (Norsk Inst. for Vannforskning, Oslo). Feb 1985. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752495.

Project RAIN is a 5-year international research project aimed at investigating the effect on water chemistry of changing acid deposition to whole catchments. The project comprises 2 parallel large-scale experimental manipulations - artificial acidification at Sogndal and exclusion of acid rain at Risdalsheia. The project began in June 1983. The first year was devoted to selection of sites, collection of background data on precipitation, runoff and soils and design and construction of roofs, watering systems, weirs and sampling devices. Treatment at Sogndal started in April 1984 with the acidification of the snowpack by addition of sulfuric acid (catchment 2) or a 1:1 mixture of sulfuric and nitric acids (catchment 4). Treatment continued in August-October 1984. Preliminary results indicate rapid and significant response in runoff chemistry to the acid treatments; pH declines to as low as 4.1 during snowmelt), SO/sub 4/, NO/sub 3/ and labile Al increase. At Risdalsheia treatment began in June 1984 with mounting of transparent panels on the roofs at KIM catchment (treatment by deacidified rain) and EGIL catchment (control with ambient acid rain). Preliminary data up to 15 October 1984 indicate a decrease in nitrate concentration in runoff from KIM catchment. 5 tables, 18 drawings, 6 photos, 7 references.

37623 (PB—87-163366/XAB) **Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia.** Salisbury, S.; Roper, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1986. 19p. (HETA—86-045-1681). NTIS, PC A02/MF A01.

A reevaluation of the air quality in the Marietta Tower Building, Atlanta, Georgia was requested by the DHHS Region IV Employee Health and Safety Committee because of worker complaints about sinus problems, eye irritation, and headaches. Air cooling and circulation units were inspected on six floors. Outside air supply to these floors was measured and the buildup of carbon dioxide determined as an indicator of indoor pollution.

37624 (PB—87-171906/XAB) **ROADWAY: a numerical model for predicting air pollutants near highways. User's guide. Final report.** Eskridge, R.; Catalano, J. (Aerocomp, Inc., Costa Mesa, CA (USA)). Mar 1987. 148p. NTIS, PC A07/MF A01.

See also PB—86-222361.

ROADWAY is a finite-difference model that solves a conservation of species equation to predict pollutant concentrations within two hundred meters of a highway. It uses surface-layer similarity theory to predict wind and eddy-diffusion profiles from temperature at two heights and wind velocity upwind of the highway. A unique feature of the model is its use of vehicle wake theory which was originally developed by Eskridge and Hunt (1979), and was modified by Eskridge and Thompson (1982); Eskridge and Rao (1983, 1985). It is assumed that vehicle wakes affect the wind and turbulence fields in a linear manner with wake intensity a function of vehicle speed, downwind distance, and distance from the wake center. The user has the option of considering NO, $NO_2$, and $O_3$ chemical reactions near the road. Output from the model consists of x-z fields of wind components, eddy-diffusion coefficients, and concentration of pollutant.

37625 (PB—87-174090/XAB) **Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois.** Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 15p. (HETA—86-223-1743). NTIS, PC A02/MF A01.

37626 (PB—87-174108/XAB) **Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio.** Stephenson, R.L.; Albrecht, W.N. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 76p. (HETA—85-482-1730). NTIS, PC A05/MF A01.

An assessment was made of possible exposure to the catalyst dimethylethylamine (DMEA) at the Winters Industry Foundry in Canton, Ohio, in response to a request from the Molders and Allied Workers Union, Local 154. Symptoms of vision disturbances consisting of blurred, foggy, or halovision had been reported by workers at the facility along with headaches and stomach pain. Long-term personal breathing-zone air samples were taken during the core-manufacturing processes and revealed the following airborne concentrations: DMEA, nondetectable to 29 mg/cum; respirable free silica, nondetectable to 1144 micrograms/cu m; methylene chloride, nondetectable to 4.7 mg/cu m; perchloroethylene, 2.2 to 6.4 mg/cu m; 1,1,1-trichloroethane, 451 to 764 mg/cu m; and total reactive isocyanate groups, nondetectable to 144 microg/cu m. No airborne concentrations of ammonia or nitrosamines were detected. Over 90% of the employees experienced at least one symptom or effect which was consistent with DMEA exposure. The authors conclude that a health hazard exists with regard to exposure to free silica. The authors recommend that concentrations of DMEA be kept as low as possible, although there are at present no regulations concerning safe levels of this chemical in the workplace.

37627 **(PB—87-174132/XAB) Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia.** Telesca, D.R. (Dynamac Corp., Rockville, MD (USA). Enviro Control Div.). 25 May 1982. 17p. NTIS, PC A02/MF A01.

A survey was conducted to investigate techniques used to control worker exposures to acrylonitrile at the Woodmar Facility of the Borg-Warner Chemicals Company in Washington, West Virginia. At this facility, many products were made including acrylonitrile butadiene styrene (ABS) resins, methyl-methacrylate butadiene styrene resins, and other modifier and reinforcing resins used to process other polymers. Personal protective equipment was used when doing certain jobs to prevent possible skin or eye contact with the chemicals. Operators and maintenance personnel were trained in each operation and task they might encounter so as to minimize possible exposures. Safety standards were in existence which address health hazards of chemicals, mode of emission of chemicals, and control techniques to be used. Management follow-up and monitoring programs were designed to ensure consistent application of work practices throughout the facility.

37628 **(PB—87-174140/XAB) Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California.** Belanger, P.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 17p. (HETA—86-339-1741). NTIS, PC A02/MF A01.

Possible exposure to several chemical substances during the fabrication of power-supply modules was investigated at the EMCO High Voltage Company, Sutter Creek, California, at the request of an employee. Environmental air samples were collected during the coating and developing process and during the epoxy potting operation. Samples were analyzed for chlorobenzene and xylenes; no overexposures were registered. No overexposure was observed to butyl-glycidyl-ether and no detectable levels of epichlorohydrin, cyclohexanone, 2-methoxyethanol, or 2-ethoxyethanol were found. During the pot soldering operation there was a potential for exposure to the fluxing agent, 3% hydrochloric-acid, and the operator had complained of throat and nose irritation. The author recommends that the fabrication operator wear protective gloves during coating and developing of copper boards. Gloves and goggles should be worn when weighing out the sodium-persulfate and when removing panels from the bench top etcher. Local exhaust ventilation with a movable duct should be used during the pot soldering operation.

37629 **(PB—87-174173/XAB) Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington.** Apol, A.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 14p. (HETA—85-518-1737). NTIS, PC A02/MF A01.

Possible exposure to solvent vapors during the making of graphite fishing rods was investigated at the LCI Excelon facility, Woodland, Washington in response to a request from the management. Acetone and xylene vapor exposure levels ranged from 1 to 50% of the recommended limits of 250 parts per million (ppm) for acetone and 100ppm of xylene. Headaches and dizzines were reported by workers exposed to the solvent vapors. Exposure to 2-ethoxyethyl acetate and 2-ethoxyethanol was 92% of the recommended ACGIH levels of 5ppm for each. Even so, the evidence for reproductive effects of 2-ethoxyethanol makes this an undesirable exposure condition. Exposure to n-butyl-alcohol and methyl ethyl ketone were also determined. The authors recommend eliminating the use of materials containing 2-ethoxyethanol or 2-ethoxyethyl acetate, providing local exhaust ventilation, reducing the temperature of the iron used for tacking, labelling solvent containers, and using only safety cans and plunger cans for transferring and dispensing solvents.

37630 **(PB—87-174199/XAB) Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York.** Lee, S.A.; Bennett, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 42p. (HETA—84-458-1733). NTIS, PC A03/MF A01.

Possible exposure to substances used in the making of urethane-foam seals and synthetic-bristle brushes was investigated at Schlegel, Inc., Rochester, New York, in response to a request by employees. An environmental survey was conducted in the Polyurethane Department and the Spiral Wind Department, and 62 workers took part in a medical survey. Medical examination revealed that two nonsmoking workers in the Polyurethane Department had an obstructive pulmonary-function test pattern, which may be indicative of overexposure to toluene-diisocyanate. The authors conclude that there may have been a hazard from methylene chloride exposure in the Polyurethane Department. Overexposures were not found in the Spiral Wind Department, although at the time of the study, the work force in the Spiral Wind Department had been reduced from 21 to three workers. The authors recommend changes in engineering, medical, educational and personal protection practices to reduce exposures.

37631 **(PB—87-174256/XAB) Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon.** Elliott, L.J.; Huemann, M.; Sokolow, R.; Elefant, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 29p. (HETA—85-309-1739). NTIS, PC A03/MF A01.

Evaluation of occupational and general public exposure to Bacillus thuringiensis (Bt) during application of this microbial agent for control of the gypsy moth was requested by the Oregon State Department of Human Resources, Health Division, located in Portland. Bt was applied by helicopter on about 250,000 acres of forest, rural, and urban areas in 1985 and 1986. Project operational plans, accident prevention, safety plans, personal protective-equipment usage, and work practices were reviewed and evaluated. Personal exposure and area air monitoring for Bt was carried out during application. Air sampling indicated there was a widespread exposure potential. The author recommends that care be taken by those employees handling Bt in solution and that splashing of Bt to the eye be avoided due to possible corneal ulcer development. The dispersing-agent Plyac is recommended for use in handling the waste-disposal problem. Access to the mixing and application areas should be restricted.

37632 **(PB—87-174397/XAB) NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings.** Wallingford, K.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1987. 11p. NTIS, PC A02/MF A01.

A total of 356 indoor-air-quality health-hazard evaluations were completed by NIOSH from 1971 through December of 1985. Most of these studies concerned government and private office buildings where there were worker complaints. Worker complaints resulted from contamination from inside the building (19% of the cases), contamination from outside (11 percent), contamination from the building fabric (4%), biological contamination (5%), inadequate ventilation (50%), and unknown causes (11%). Health complaints addressed by investigative efforts included eye irritation, dry throat, headache, fatigue, sinus congestion, skin irritation, shortness of breath, cough, dizziness, and nausea.

37633 **(PB—87-174629/XAB) Information profiles on potential occupational hazards: benzoin.** (Syracuse Research Corp., NY (USA). Center for Chemical Hazard Assessment). Mar 1981. 19p. (SRC-TR—81-521). NTIS, PC A02/MF A01.

Information on potential occupational hazards from exposure to benzoin was reviewed. Topics discussed included chemical and physical properties, production, uses, manufacturers and distributors, manufacturing processes, occupational exposure, and biological effects. The annual production of benzoin is approximately 90,000 pounds per year with an historical growth rate of about 6% per year. In carcinogenesis studies, the incidence of lymphomas and leukemia in dosed male rats increased with dose level, but not significantly. Mice demonstrated a significant increase in the incidence of lymphomas and leukemias at low dose levels. Bioassays have indicated that benzoin is not carcinogenic to male or female F344-rats or B6C3F1-mice. No evidence of mutagenicity, teratogenicity, or

reproductive effects was found in animal studies. Allergic contact dermatitis has been reported in humans.

37634 **(PB—87-174827/XAB) Effects of sheltering and orientation on the atmospheric corrosion of structural metals.** Carter, J.P.; Linstrom, P.J.; Flinn, D.R.; Cramer, S.D. (Bureau of Mines, Avondale, MD (USA). Avondale Research Center). Mar 1987. 26p. NTIS, PC A03/MF A01.

The Bureau of Mines, U.S. Department of the Interior, is conducting atmospheric corrosion tests on five alloys and two coated-steel products at five sites as part of the National Acid Precipitation Assessment Program. Tests were conducted on samples boldly exposed to the atmosphere, sheltered from the atmosphere, and facing skyward and groundward. Details of the corrosion process related to orientation and sheltering and involving particulates, corrosion film chemistry and morphology, and the dissolution/reprecipitation process were established. The corrosion film on zinc saturates with sulfur at around 7 wt pct with increasing ambient sulfur dioxide concentration. Zinc corrosion on the skyward side appears to be cathodically protected in two-sided old exposures. Only large particulates are present on the surface of sheltered copper and zinc; small particulates dissolve and disperse into the corrosion film. The dissolution/reprecipitation process occurs primarily during the final stages of drying. The information is essential to the development of damage models for the effects of acid deposition of metallic materials.

37635 **(PB—87-174850/XAB) Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions.** Hoffman, J.S.; Geyer, S.M.; Lestz, S.S.; Black, F.M. (Pennsylvania State Univ., University Park (USA). Dept. of Mechanical Engineering). Mar 1987. 32p. NTIS, PC A03/MF A01.

An instrument has been developed (termed the methane analytical system) enabling diesel methane emissions to be quatified separately from total unburned hydrocarbon emissions. The instrument employed gas-chromatographic principles whereby a molecular-sieve column operating isothermally separated methane from the nonmethane hydrocarbons. Direct on-line sampling occurred via constant-volume sample loops. The effluent was monitored with a flame ionization detector. The instrument was fully calibrated (i.e., extremely linear response over a large concentration range) for use with diesel engines as part of an on-going alternative-fuels research program. Methane emissions from a light-duty, multi-cylinder, indirect-injected diesel engine fumigated with natural gas were measured on-line using the methane analytical system. Methane emissions were found to range from as low as 250 ppm to a high of nearly 2%. The nonmethane hydrocarbon emissions were determined by subtracting the methane level from the total unburned hydrocarbon level. In the event that the federal engine certification procedures are changed to be based on nonmethane hydrocarbon emissions, a methane analytical system such as the one described here would have great utility.

37636 **(PB—87-174967/XAB) Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry.** Arnts, R.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 9p. (EPA—600/J-85/477). NTIS, PC A02/MF A01.

Pub. in J. of Chromatography, Vol. 329, 399-405(1985).

Gas chromatographic-mass spectrometric (GC/MS) identification of air pollutants generally requires a preconcentration step to provide sufficient sample for analysis. Cryogenic trapping is often used to enrich the sample since nitrogen and oxygen are not condensed. It does, however, concentrate enormous quantities of water and carbon dioxide - enough to plug high-resolution narrow-bore capillary columns needed for separation of complex environmental samples. Whole-air samples were collected in stainless steel containers or Tedlar bags for analysis by gas chromatography with flame ionization detection (GC/FID). In order to provide identification of unknown peaks and confirmation of tentatively named peaks, the system described herein was designed and built to enrich samples for GC/MS analysis of volatile organics. The preconcentration system consists of a solid sorbent trap and a cryogenic trap used in sequence to collect organic vapors and focus them for analysis by GC/MS.

37637 **(PB—87-174975/XAB) Second performance audit of inspection and maintenance calibration gases.** Wright, R.S.; Moore, C.E.; Decker, C.E.; Barnard, W.F. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1987. 16p. NTIS, PC A02/MF A01.

The purpose of the audit was to determine the accuracy of calibration gases being used by state and local inspection and maintenance (I/M) programs. Forty-six calibration gas cylinders were borrowed from 16 representative I/M programs. Typically, they contained propane (or hexane), carbon monoxide, and carbon dioxide in nitrogen. Research Triangle Institute (RTI) analyzed these calibration gases using nondispersive infrared photometry and gas chromatography with flame ionization and thermal-conductivity detectors.

37638 **(PB—87-174991/XAB) Air-pollution models as descriptors of cause-effect relationships.** Lamb, R.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1983. 18p. (EPA—600/J-84/397). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 18, No. 3, 591-606(1984).

The problem of air-pollution modeling is treated beginning from a philosophical standpoint, in which a model is viewed as a universal statement and a complementary set of singular statements from which specific cause-effect relationships are deduced; proceeding to the formulation of a specific model from fundamental physical principles. In the course of the analyses, a number of basic issues are examined. These include the types of information that an air-pollution model is capable of providing (it is shown that specific events are not predictable, only the set of possible events can be described); the problem of model validation (even with a perfect model and error-free input data and observations, discrepancies will exist between predicted and observed quantities); the character and representation of long-range dispersion (the conventional concepts of transport and diffusion become ill-defined when applied within the context of long-range dispersion models); and other topics relevant to the use of models in decision-making processes.

37639 **(PB—87-175048/XAB) Nitric acid-air diffusion coefficient: experimental determination.** Durham, J.L.; Stockburger, L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 8p. (EPA—600/J-86/289). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 20, No. 3, 559-563(Mar 1986).

Trace gaseous $HNO_3$ in air is removed in a laminar-flow nylon tube. The $HNO_3$ deposition pattern was obtained by sectioning the tube, extracting with an aqueous solution, and measuring the concentration by ion chromatography. Mass-transport analysis of the deposition pattern demonstrated the $HNO_3$ was removed from the air stream at a rate controlled by gaseous diffusion. The $HNO_3$-air diffusion coefficient = 0.116 + or - 0.003 sq cm/s (n = 7) for t = 298 K and p = 1 atm. It exhibited no dependence on relative humidity over the range 5 - 95%.

37640 **(PB—87-175519/XAB) Analysis and evaluation of statistical coastal fumigation models.** SethuRaman, S. (North Carolina State Univ., Raleigh (USA). Dept. of Marine, Earth and Atmospheric Sciences). Feb 1987. 214p. NTIS, PC A10/MF A01.

The report summarizes the result of a study to evaluate two coastal dispersion models using a comprehensive coastal dispersion data base. A sensitivity analysis of the various model input parameters indicates that the height of the Thermal Internal Boundary Layer (TIBL) is the most-sensitive variable. Six equations to describe the TIBL height are identified from the scientific literature and compared using two experimental data bases. The report concludes that the Misra Shoreline Fumigation Model using the Weisman equation to characterize the TIBL is the base coastal fumigation model.

37641 **(PB—87-175576/XAB) National Air Toxics Information Clearinghouse (NATICH) data base user's guide for data entry and editing. Interim report.** Smith, S.A. (Radian Corp., Austin, TX (USA)). 23 Feb 1987. 95p. NTIS, PC A05/MF A01.

See also report dated Sep 1985, PB—86-123601.

This report will serve as guide for State and local agency personnel entering data into the National Air Toxics Information Clearinghouse (NATICH) data base. The NATICH data base is computerized and contains indexed information on toxic and potentially toxic air pollutants. The data base was established by EPA to support State and local programs in the control of non-criteria air pollutants.

37642 **(PB—87-176574/XAB) Air-Quality Criteria for Particulate Matter and Sulfur Oxides (1982) (second addendum): assessmet of newly available health-effects information. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Dec 1986. 217p. (EPA—600/8-86/020F). NTIS, PC A10/MF A01.

See also report dated July 1986, PB—86-221249.

The second addendum to the Air Quality Criteria for Particulate Matter and Sulfur Oxides evaluates and assesses new scientific information that have emerged since 1982 and their implications for derivation of health-related criteria for particulate matter and sulfur oxides NAAQS. Accordingly, the present addendum; (1) concisely summarizes key findings from the 1982 EPA criteria document and first addendum as they pertain to derivation of health-related criteria; and (2) provides an updated assessment of newly available information of potential importance for derivation of health criteria for both the particulate matter and sulfur oxides standards, with major emphasis on evaluation of human-health studies published since 1982. Certain background information of crucial importance for understanding the assessed health effects findings is also concisely summarized. This includes information of physical and chemical properties on particulate matter, sulfur oxides, and associated aerosols and ambient monitoring techniques.

37643 **(PB—87-176608/XAB) Simulation of aerosol dynamics: a comparative review of mathematical models.** Seigneur, C.; Hudischewskyj, A.B.; Seinfeld, J.H.; Whitby, K.T.; Whitby, E.R. (Systems Applications, Inc., San Rafael, CA (USA)). 1986. 20p. NTIS, PC A02/MF A01.

Pub. in Aerosol Science and Technology, Vol. 5, 205-222(Apr 1986).

Three modeling approaches used are based-continuous, discrete (sectional), and parameterized representations of the aerosol size distribution. Simulations of coagulation and condensation are performed with the three models for clear, hazy, and urban atmospheric conditions. Relative accuracies and computational costs are compared. Reference for the comparison is the continuous approach. The results of the study provide useful information for the selection of an aerosol model, depending on the accuracy requirements and computational constraints associated with a specific application.

37644 **(PB—87-176624/XAB) Remote measurement of sulfur dioxide emissions using an ultraviolet-light-sensitive video system.** McElhoe, H.B.; Conner, W.D. (Northrop Services, Inc., Research Triangle Park, NC (USA)). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 36, 42-47(1986).

Remote measurements of sulfur dioxide emissions were made using a portable ultraviolet (uv) light-sensitive video system. The instrument system measures the uv light attenuation caused by sulfur dioxide in the effluent plume and relates this absorption to the sulfur dioxide concentration. Laboratory and field tests were conducted to establish the potential for using the technique for rapid surveillance of sulfur dioxide emissions. The laboratory studies included testing by viewing cells containing known concentrations of sulfur dioxide and measuring the emissions from a modified smoke generator. The field study was performed in two stages. Sulfur dioxide emissions were measured at a typical coal-fired power plant (concentrations ranged from 80 to 365 ppm). The elevated concentrations were obtained by reducing flue gas scrubber efficiencies. The second stage involved participation in an urban particulate modeling study which involved routine sulfur dioxide emissions measurements at 12 industrial sites.

37645 **(PB—87-176632/XAB) Identification of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate in the Los Angeles atmosphere.** Eatough, D.J.; White, V.F.; Hansen, L.D.; Eatough, N.L.; Cheney, J.L. (Brigham Young Univ., Provo, UT (USA)). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 20, No. 9, 867-872(1986).

Analytical techniques were developed for the collection and determination of gas-phase dimethyl sulfate and monomethyl sulfuric acid based on collection of the alkyl sulfate compounds with both denuder tubes and resin sorption beds and analysis of the collected material by ion chromatography. Gas-phase dimethyl sulfate and monomethyl sulfuric acid were identified in Los Angeles using these techniques. The data indicate that dimethyl sulfate is present in both particles and in the gas phase. The concentration of gas-phase methyl sulfates was found to be several micrograms/cu m. These species thus account for a significant fraction of the total sulfur budget in the Los Angeles Basin during the sample period.

37646 **(PB—87-176699/XAB) Transition-flow reactor tube for measuring trace-gas concentrations.** Durham, J.L.; Ellestad, T.G.; Stockburger, L.; Knapp, K.T.; Spiller, L.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 7p. (EPA—600/J-86/308). NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 36, 1228-1232)1986).

Dry deposition contributes significantly to the acidification of ecosystems. However, difficulties in measuring dry deposition of reactive gases and fine particles make routine direct monitoring impractical. An alternate approach is to use the concentration monitoring method in which dry deposition is estimated from the product of measured concentration and estimated deposition velocity. A sampling system that performs over the period of 6 hours to 7 days, depending on atmospheric concentrations, was developed. It consists of a Teflon cyclone to exclude particles larger than about 2 micrometers, selective solid-adsorption media for reactive gases - some of which are sampled from a transition flow to avoid bias from particle evaporation, a particle filter, and a final gas-adsorption filter to collect the remaining trace gas. Laboratory and field tests have shown that the sampler performs well for $HNO_3$(g).

37647 **(PB—87-176921/XAB) Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985).** de Meulemeester, A.; de Roocker, A.; Long, M.; Origoni, G. (Concawe, The Hague (Netherlands)). 1986. 17p. (CONCAWE—10/86). NTIS, PC PC E03/MF E01.

See also report for 1979 and 1982, PB—85-231678.

The survey made by CONCAWE for 1985 of the amount of sulfur received into refineries and its subsequent disposition, taken together with the earlier 1979 and 1982 surveys, illustrates the ongoing decrease in the oil industry's contribution to the sulfur emissions burden on the European environment. The data provided to CONCAWE was extrapolated to compile an overall sulfur mass balance for Western Europe. Sulfur input with crude oil and other feedstocks was evaluated against the refinery outputs through the sulfur contents of oil products, the level of sulfur recovery, and sulfur dioxide emissions from refinery stacks. The main conclusions are that between 1979 and 1985 the sulfur content of oil products for combustion fell by 62% and sulfur emitted from refinery stacks reduced by 40%. The refinery contribution to total man-made sulfur dioxide emissions continued to reduce, and in 1985 it was 6.5%.

37648 **(PB—87-177341/XAB) Experimental study of sulfur and NOx fluxes over grassland.** Hicks, B.B.; Wesely, M.L.; Coulter, R.L.; Hart, R.L.; Durham, J.L. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA)). 1986. 21p. NTIS, PC A02/MF A01.

On theoretical grounds it is expected that particulate sulfate will deposit more slowly than $SO_2$. While micrometeorological measurements of the deposition velocity of $SO_2$ are relatively

common, similar simultaneous measurements for sulfate have not been reported. To measure their relative deposition velocities, as well as that of NOx, a field study was conducted over ungrazed grass in central Ohio in September 1979. Daytime deposition velocities for $SO_2$ were typically 0.8 cm/sec, while for sulfate typical daytime values were 0.4 cm/sec, which is noticably higher than commonly assumed values.

37649 **(PB—87-177515/XAB) Reburning application to firetube package boilers. Final report, May 1983-September 1985.** Mulholland, J.A.; Stephenson, E.E.; Pendergraph, C.; Ryan, J.V. (Acurex Corp., Mountain View, CA (USA)). Mar 1987. 442p. NTIS, PC A19/MF A01.

The report gives results of pilot-scale experimental research that examined the physical and chemical phenomena associated with the NOx control technology of reburning applied to gas- and liquid-fired firetube package boilers. Reburning (staged fuel combustion) diverts some of the fuel and combustion air from the main burner(s) for injection into the post-flame gases, resulting in three distinct zones in the boiler radiant section: a fuel-lean primary zone, a fuel-rich reburning zone, and a fuel-lean burnout zone. NOx is reduced both by reduction of NOx formation and by destruction of primary-flame NOx by secondary-fuel radicals. The research showed that, with minimal facility modification, NOx emissions from a firetube package boiler can be reduced by 50% or more from an initial level of 200 ppm (measured dry, at zero % O2). Several hypotheses were evaluated in the study. Results indicate that the overall NOx reduction via reburning has a reaction rate order of about 1.5 with respect to primary NOx.

37650 **(PB—87-178828/XAB) Review of national emission standards for mercury (final environmental impact statement).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1987. 39p. (EPA—450/3-84/014B). NTIS, PC A03/MF A01.

See also report dated Dec 84, PB—85-153906.

The report summarizes public comments that were made on the proposed revisions to the national emission standards for the hazardous air pollutant mercury. The document also provides the Environmental Protection Agency's responses to those comments. Changes made to the final revisions (since proposal) are briefly described.

37651 **(PB—87-179263/XAB) Development of audit devices and materials for source-level air=pollution-measurement methods.** Logan, T.J.; Midgett, M.R.; Fuerst, R.G.; DeWees, W.G. (Entropy Environmentalists, Inc., Research Triangle Park, NC (USA)). Apr 1987. 19p. NTIS, PC A02/MF A01.

The paper describes the procedures followed by the U.S. Environmental Protection Agency (EPA), Quality Assurance Division, when developing a source-level audit device or material (d/m). The audit d/m's are used to quantitatively determine that an EPA reference method is being properly performed by an analyst. The procedure to develop and audit d/m is described by discussing the development of an audit material for EPA reference Method 5, Determination of Particulate Emissions from Stationary Sources. The paper also presents a list of all audit d/m's currently available from the EPA Quality Assurance Division.

37652 **(PB—87-179271/XAB) Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985.** Lawless, P.A.; Ensor, D.S.; Sparks, L.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1987. 16p. (EPA—600/D-87/070). NTIS, PC A02/MF A01.

The paper discusses detailed numerical calculations of particle charge and extinction coefficient performed using current models. The results suggest that information about rapping reentrainment, back corona, and, possibly, sulfuric acid condensation can be gained from simultaneous outlet measurements of opacity and space charge. Some experimental observations based on semi-continuous measurements have confirmed these results in a general way and point to the use of the method as a precipitator diagnostic tool.

37653 **(PB—87-179289/XAB) Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for September 1985-April 1986.** Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). Apr 1987. 21p. NTIS, PC A02/MF A01.

The paper gives results of an evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Pilot-plant data showed that the dissolved magnesium in thiosorbic lime caused deterioration of solids dewatering properties. The slurry settling rate increased when the slurry shear stresses caused by the hold-tank stirrer and recirculation pump were reduced. The application of flocculant also increased the slurry-solids settling rate. Compared with rotary-drum vacuum filtering, better liquid/solids separation occurred with a centrifuge. Other related performance results are also discussed.

37654 **(PB—87-179826/XAB) Control of atmospheric fine primary carbon particle concentrations. Final report.** Gray, H.A. (California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.). Feb 1986. 357p. (EQL—23). NTIS, PC A16/MF A01.

In the study, procedures for the engineering design of fine carbonaceous particulate-matter abatement strategies are developed and tested in the Los Angeles area. Carbon-particle abatement strategies are evaluated based on the results of an emissions to air-quality model, the performance of which is verified by comparison to measurements of ambient aerosol concentrations taken in the South Coast Air Basin during 1982. Linear-programming techniques are employed to identify the least costly set of emission-control measures that would enable a variety of possible air-quality goals to be met. Solutions indicate that application of specified control measures, especially those directed toward diesel engines, will reduce the basin-wide maximum annual average fine elemental-carbon concentration approximately by half at an annual cost of about $69 million. The maximum annual average fine primary particulate total carbon concentration may be reduced by about 35% at a cost of $102 million per year.

37655 **(PB—87-179990/XAB) Chemistry of oxidant formation: implications for designing effective control strategies.** Dodge, M.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Apr 1987. 26p. (EPA—600/D-87/114). NTIS, PC A03/MF A01.

A simple moving-box model was used to assess the effect of various control strategies on predictions of ozone formation in urban areas. It was found that the effectiveness of a proposed control measure depends critically on the ratio of the Volatile Organic Compounds (VOC) and NOx precursors that are emitted into the urban environment. Depending on the assumptions made about the ratio of the VOC and NOx emissions, a strategy involving simultaneous control of VOC and NOx can be more or less effective in reducing downwind ozone levels than a strategy involving reduction of only VOC. In all cases, however, it was found that NOx control, by itself, has a detrimental impact on ozone levels near source areas. Further, when NOx control accompanies VOC control, ozone concentrations near source areas are higher than would occur if VOC alone is reduced. NOx control, therefore, could result in greater population exposure to high ozone levels than would be the case if only VOC is reduced.

37656 **(PB—87-180048/XAB) Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters.** Cheney, J.L.; Fortune, C.R.; Turlington, C.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1984. 18p. (EPA—600/J-84/401). NTIS, PC A02/MF A01.

Pub. in Jnl. of Environmental Science and Health A19, No. 3, 351-366(1984).

Potential interferences in the anhydrous isopropanol (a-IPA) extraction method for separating sulfuric acid from particulate sulfate on filters were investigated. The method involves separation and recovery of the acid with a-IPA, followed by aqueous extraction of the particulate. Analysis for sulfate in the separate fractions was performed by ion chromatography. The solubility of ammoni-

um sulfate in a-IPA was measured, and the effects of temperature and moisture content of the solvent on ammonium sulfate solubility were determined. Neither a small uptake of moisture by the a-IPA nor elevated temperatures up to 30 C had a significant effect on the solubility of ammonium sulfate in IPA. Ammonium sulfate was determined to be very highly insoluble in a-IPA and therefore, exposure of samples to any source of ammonia will result in low recoveries of sulfuric acid by the solvent-recovery procedure.

37657 **(PB—87-180352/XAB) National air quality and emissions trends report, 1985.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1987. 231p. (EPA—450/4-87/001). NTIS, PC A11/MF A01.

See also report for 1984, PB—86-192044.

This report presents national and regional trends in air quality from 1976 through 1985 for total suspended particulate, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. Air-pollution trends were also examined for the 5-year period (1981-85) to take advantage of the larger number of sites and the fact that the data from the post-1980 period should be of the highest quality. Both national and regional trends in each of the major pollutants are examined. National air-quality trends are also presented for both the National Air Monitoring Sites (NAMS) and other site categories. In addition to ambient air quality, trends are also presented for annual nationwide emissions. These emissions are estimated using the best available engineering calculations: the ambient levels presented are averages of direct measurements. The report also includes a section, Air Quality Levels in Metropolitan Statistical Areas (MSA's). Its purpose is to provide interested members of the air-pollution control community, the private sector, and the general public with greatly simplified air-pollution information. Air-quality statistics are presented for each of the pollutants for all SMSA's with populations exceeding 500,000 for the years 1983, 1984 and 1985.

37658 **(PB—87-180360/XAB) Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report).** Hegg, D.A.; Hobbs, P.V. (Washington Univ., Seattle (USA). Dept. of Atmospheric Sciences). Oct 1986. 44p. NTIS, PC A03/MF A01.

See also annual report, dated Oct 1984, PB—85-144350.

This report summarizes work conducted during the second year of a study of the interactions of nitrogen species with clouds. Research during the second year centered on resolution of several important issues. First, airborne cloud-water collectors currently in use by the research community are poorly characterized with regard to collection efficiency and the effects of collection on chemical composition. Both points have been addressed with respect to the two cloud-water samplers that Washington is using. No evidence for chemical modification of samples by the collection process was found. Secondly, analysis of the mass ratio of cloud water nitrate to sulfate in marine and continental clouds confirms that this ratio is a good indicator of the degree to which clouds have been continentalized. Finally, preliminary analysis of data acquired with the new airborne sampling system were analyzed for evidence of nitrate production in clouds. As part of the research, new instrumentation for the detection of low levels of $HNO_3$, $NO_2$, and PAN were flown and tested on the Washington aircraft.

37659 **(PB—87-180584/XAB) Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain.** Morris, R.E.; Kessler, R.C. (Systems Applications, Inc., San Rafael, CA (USA)). Apr 1987. 469p. NTIS, PC A20/MF A01.

Existing mesoscale meteorological and acid-deposition models are surveyed, reviewed, and evaluated for potential application of a complex-terrain region within the Rocky Mountain region. The purpose of the review is to choose meteorological and acid-deposition modules that might be included in a mesoscale acid-deposition model for the Rocky Mountain region. This acid-deposition model would then be used by the western regulatory agencies to estimate the amounts of acidic deposition from proposed new sources at PSD class 1 and acid-sensitive areas.

37660 **(PB—87-180592/XAB) Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 1. Adaptation of the mechanism. Final report, March 1986-February 1987.** Lurmann, F.W.; Carter, W.P.L.; Coyner, L.A. (Environmental Research and Technology, Inc., Newbury Park, CA (USA)). Apr 1987. 211p. NTIS, PC A10/MF A01.

See also Volume 2, PB—87-180600.

A surrogate-species chemical mechanism was refined, evaluated, and adapted for use in air-quality simulation (AQS) models. The refined mechanism was evaluated against data from 491 environmental chamber experiments conducted in indoor and outdoor facilities. Results of the evaluation indicate that the mechanism's predictions are qualitatively and quantitatively consistent with data from a large number of single organic-NOx and multi-organic-NOx experiments. Subsequent to the testing of the mechanism, versions of the mechanism were adapted for use in single-cell models such as OZIPM/EKMA and multi-cell AQS models. Guidelines for using these mechanisms were also developed. The guidelines include specifying procedures for assignments of individual organic species to the chemical classes in the mechanisms and for selecting organic-speciation profiles when ambient data are not available. Volume I describes the adaptation of the mechanism for AQS use; Volume II serves as the user's guide for implementing the mechanism in OZIPM/EKMA or multi-cell AQS.

37661 **(PB—87-180600/XAB) Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 2. Guidelines for using the mechanism. Final report, March 1986-February 1987.** Lurmann, F.W.; Carter, W.P.L.; Coyner, L.A. (Environmental Research and Technology, Inc., Newbury Park, CA (USA)). Apr 1987. 116p. NTIS, PC A06/MF A01.

See also Volume 1, PB—87-180592.

A surrogate-species chemical mechanism was refined, evaluated, and adapted for use in air quality simulation (AQS) models. The refined mechanism was evaluated against data from 491 environmental chamber experiments conducted in indoor and outdoor facilities. Results of the evaluation indicate that the mechanism's predictions are qualitatively and quantitatively consistent with data from a large number of single organic-NOx and multi-organic-NOx experiments. Subsequent to the testing of the mechanism, versions of the mechanism were adapted for use in single-cell models such as OZIPM/EKMA and multi-cell AQS models. Guidelines for using these mechanisms were also developed. The guidelines include specifying procedures for assignments of individual organic species to the chemical classes in the mechanisms and for selecting organic-speciation profiles when ambient data are not available. Volume I describes the adaptation of the mechanism for AQS use; Volume II serves as the user's guide for implementing the mechanism in OZIPM/EKMA or multi-cell AQS.

37662 **(PB—87-180659/XAB) Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study.** Dodge, M.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 1984. 11p. (EPA—600/J-84/403). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 18, No. 8, 1657-1665(1984).

A modeling study was undertaken to assess the effect of organic reactivity on photochemical-oxidant formation. A six-component hydrocarbon model was developed and tested against data collected in a smog chamber study of irradiated auto exhaust and oxides of nitrogen NOx mixtures. The model was then adjusted to conditions that closely approximated those of the urban environment and used to assess the relative reactivity of various organic constituents present in an urban-like air mass. Twelve organics were investigated in the study: ethane, propane, n-butane, ethylene, propylene, trans-2-butene, toluene, m-xylene, methanol, ethanol, formalehyde, and acetaldehyde. The findings of this study indicate that the reactivity of organics depends strongly on the hydrocarbon-to-NOx ratio of the mix in which they are reacting. At low hydrocarbon-to-NOx ratios, the organics investigated in this study displayed significantly different $O_3$-forming potentials. At high hydro-

carbon-to-NOx ratios, however, all organics exhibited comparable O to 3-forming potential.

37663 **(PB—87-180667/XAB) Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version).** Egan, B.A.; Schiermeier, F.A. (American Meteorological Society, Boston, MA). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Bulletin of the American Meteorological Society, Vol. 67, No. 10, 1240-1247(Oct 1986); See also PB—86-122694.

This article summarizes the contributions of participants attending a workshop convened under the direction of the AMS Steering Committee for the EPA Cooperative Agreement on Air Quality Modeling. The purpose of the workshop was to address the status of our understanding of diapersion in complex or mountainous terrain settings, with a specific focus on the ability of current technologies to predict air-pollution concentrations in different terrain settings.

37664 **(PB—87-180758/XAB) Episodic coincident air-quality and precipitation measurements in an urban setting.** Patrinos, A.A.N.; Binkowski, F.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 7p. (EPA—600/D-87/115). NTIS, PC A02/MF A01.

Pub. in J. Conf. on Applic. of Air Poll. Meteorol. (APCA/AMS) (5th), Chapel Hill, NC, November 18-21, 1986, 7-10.

Coincident measurements of air quality and precipitation chemistry showed small gradients for summer showers in an urban area. For frontal cases the gradients were weak.

37665 **(PB—87-181053/XAB) Modern continuous samplers for volatile organics and inorganic gases.** McClenny, W.A.; Paur, R.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Apr 1987. 24p. (EPA—600/D-87/125). NTIS, PC A02/MF A01.

The manuscript discusses EPA methods development in two areas: VOC monitoring and monitoring of dry-depositon components. Whole-air collection over periods of up to one day in specially prepared stainless steel canisters is beginning to be used routinely for volatile organic compounds (VOCs), although the use of solid adsorbents like Tenax is still the primary means for collection. Selective accumulation of target species in increasingly concentrated form as sampling time increases, as for collection of ambient particulate matter, or for capture of target gases on a specially prepared surface, is being used for sampling dry-deposition components over periods of up to one week. The average value of the slope of the linear regression of Tenax mean versus canister mean was 0.95, while slope values for individual compounds varied from 0.80 + or - 0.06 to 1.10 + or - 0.17. Similar outdoor-air study results showed a significant deterioration in agreement. Currently three versions of dry-deposition samplers are being compared and evaluated. These are the filter pack, transition-flow reactor, and the annular denuder system. Results from EMSL comparison studies during the fall of 1986 show surprisingly good agreement among all three.

37666 **(PB—87-181236/XAB) National air-pollutant-emission estimates, 1940-1985. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1987. 79p. (EPA—450/4-86/018). NTIS, PC A05/MF A01.

See also report for 1940-1984, PB—86-121100.

The report presents estimates of trends in nationwide air-pollutant emissions for the six major pollutants: sulfur oxides, particulates, carbon monoxide, volatile organic compounds, nitrogen oxides, and lead. Estimates are broken down according to major types of air pollutant sources. A short analysis of emission trends is given, along with a discussion of methods used to develop the data.

37667 **(PB—87-182077/XAB) Dry deposition of acidic gases and particles. Final report.** John, W.; Wall, S.M.; Ondo, J.L.; Wang, H.C. (California Dept. of Health Services, Berkeley (USA). Air and Industrial Hygiene Lab.). Feb 1986. 73p. (CA/DOH/AIHL/SP—40). NTIS, PC A04/MF A01.

The major objective of the study was to provide measurement methods and base-line data on dry acid deposition in California. A hydrogen peroxide bubbler was successfully tested to measure $SO_2$ at ppb levels. Direct measurements of acidic-particle deposition on leaves of ligustrum, pine needles, and surrogate surfaces gave results of high degree of reproducibility. Additionally, a Berner impactor (named after Dr. Berner of Austria) was tested and found to be an excellent sampler for acidic particles. The sampler was characterized in the laboratory and was found to have sharp particle-size separations. Losses of ammonium nitrate from volatilization in the impactor were found to be relatively small. Size distributions for strong acid, sulfate, nitrate, ammonium, sodium and chloride ions were obtained at Berkeley and Oildale.

37668 **(PB—87-182655/XAB) Comparison of electrostatic-precipitator performance with pulse and d-c energization.** Sparks, L.E.; Ramsey, G.H.; Valentine, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Oct 1981. 23p. (EPA—600/D-87/134). NTIS, PC A02/MF A01.

Presented at International Conference on Electrostatic Precipitation, Monterey, CA., 15 Oct 1981.

This paper compares electrostatic-precipitator (ESP) performance with pulse and direct-current (d-c) energization. Pulse power for ESPs has been offered as a possible solution to the problems associated with collecting dust with high electrical resistivity in ESPs. Data are presented to show a dramatic improvement in ESP performance for pulse vs. d-c power supply. In addition to pilot-plant tests, EPA participated in a field evaluation of pulse energization of a hot-side ESP. Results of these experiments are discussed in the paper, along with an economic analysis of pulse power.

37669 **(PB—87-182663/XAB) Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987.** Jozewicz, W.; Chang, J.C.S.; Sedman, C.B.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). Apr 1987. 29p. NTIS, PC A03/MF A01.

This paper gives results of tests of novel silica-enhanced lime sorbents in a bench-scale sand-bed reactor for their potential for $SO_2$ removal from flue gas. Reactor conditions were: 64 C, relative humidity 60% (corresponding to an approach to saturation temperature of 10C), and inlet $SO_2$ concentration 500 or 1000 ppm. The sorbents were prepared by pressure hydration of CaO or $Ca(OH)_2$ with siliceous materials at 100-230 C(101-2793 kPa) for from 15 min. to 4 h. The optimum temperature range for the pressure hydration of fly ash with $Ca(OH)_2$ was 110-160 C. The pressure hydration of diatomaceous earth with CaO did not offer significant reactivity advantages over atmospheric hydration; however, the rate of enhancement of $Ca(OH)_2$ conversions was much faster with pressure hydration. SEM and x-ray-diffraction studies showed solids of different morphology with different fly ash/lime ratios and changing conditions of pressure hydration.

37670 **(PB—87-182671/XAB) Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process.** Kirchgessner, D.A.; Hendriks, R.V.; Kaplan, N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Apr 1987. 32p. (EPA—600/D-87/136). NTIS, PC A03/MF A01.

This paper discusses EPA research on dry-sorbent injection, which began in the late 1960s and early 1970s, and which will be demonstrated as the limestone-injection multistage burner (LIMB) process at Ohio Edison's Edgewater plant in 1987. The effect and interrelationship of fundamental sorbent properties are now fairly well understood. These considerations, along with pilot-scale furnace testing, suggest that commercial calcium hydroxide will be the sorbent of choice for the demonstration. Ongoing research at EPA

is focused on the modification of commercial sorbents to make them more reactive with $SO_2$. The effects of sorbent injection on boiler efficiency, particulate collection, and solid-waste handling and disposal have been studied, and negative effects can apparently be remedied by available techniques.

37671 **(PB—87-183000/XAB) Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo.** McMillen, R.T.; Matt, D.R.; Hicks, B.B.; Womack, J.D. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Feb 1987. 75p. (NOAA-TM-ERL-ARL—152). NTIS, PC A04/MF A01.

Also pub. as National Oceanic and Atmospheric Administration, Oak Ridge, TN. Atmospheric Turbulence and Diffusion Div. rept. no. ATDD/CONTRIB—86/29.

Measurements of dry deposition of $SO_2$ are reported for a forested site in the Black Forest of West Germany. The measurements were made using the eddy-correlation method about 10 meters above the top of a spruce forest that was already affected by Waldsterben. These measurements were conducted as one component of TULLA, a large sulfur mass-balance experiment. The dry-deposition measurements were successful during times when $SO_2$ concentrations were greater than 5 micro grams/cu m.

37672 **(PB—87-183067/XAB) Utilization and stabilization of mineral wastes. Bulletin.** Dean, K.C.; Froisland, L.J.; Shirts, M.B. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Research Center). 1986. 52p. (BM-B—688). NTIS, PC A04/MF A01.

Library of Congress catalog card No. 86-600205.

This report summarizes laboratory research conducted by the Bureau of Mines and cooperative field studies made with the mineral industry to reduce the environmental impacts of air and water pollution deriving from mineral wastes. Research showed that both dry-press and steam-cured building bricks and ceramic tile could be made from copper-mill tailings and other discarded mineral wastes. Sponge iron was produced from steel mill and lamination-industry wastes, and valuable mineral products were extracted from such diverse sources as flue dusts and uranium tailings. Mineral wastes were combined with agricultural and/or sewage wastes to make artificial soils that have the potential of resolving several disposal problems by production of a useful commodity. Physical, chemical, and vegetative stabilization methods were evaluated, singly and in combination, for reclamation potential on copper, uranium, lead-zinc, and asbestos tailings.

37673 **(PB—87-183240/XAB) Mount St. Helens: the aftermath.** Flaherty, D.C. (Office of Water Research and Technology, Washington, DC (USA)). 1983. 69p. NTIS, PC A04/MF A01.

During the May 18, 1980 eruption of Mount St. Helens, ash fell over a 100,000 sq mile area to the east. The Idaho studies showed that, although the ashfall altered the food chains of some forest streams, within a year they fully recovered. The effects of ashfall on lake benthic organisms are still being assessed by sediment sampling. The Montana studies reported on snow avalanche models adapted to mudflows, trophic impact of ash deposits on Montana lakes, and the volcanic ash as nutrient subsidy to subalpine lakes. The Oregon studies reported herring and smelt egg and larvae damage due to suspended ash. The drainage patterns in eruption debris were studied along with the filling of Columbia River berths with ash.

37674 **(PB—87-183414/XAB) Preliminary compilation of air-pollutant emission factors for selected air toxic compounds.** Pope, A.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Apr 1987. 65p. (EPA—450/4-86/010A). NTIS, PC A04/MF A01.

See also PB—86-138086.

This report presents emission factors for selected air toxic compounds, and it associates the emission factors to levels of source activity. The majority of the emission factors in the report was previously presented in Appendix H of the EPA report, Compiling Air Toxic Emission Inventories, EPA-450/4-86-010. Appendix H was updated to include emission factors for ethylene oxide and chlorobenzenes. The emission factors were compiled primarily in two series of EPA reports, Locating and Estimating Air Emissions From Sources Of (Substance) and Survey of (Substance) Emission Sources. The purpose of the report is to offer a technical service to air-pollution-control agencies in performing preliminary estimates of air-toxics emissions. The emission factors are preliminary, and they are not intended to provide exact estimates of releases of air toxics from specific facilities.

37675 **(PB—87-183521/XAB) Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma.** Kominsky, J.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 121p. (HETA—85-289-1738). NTIS, PC A06/MF A01.

A request was made by the United States Postal Service to assess potential contaminationn from a soot-producing electrical transformer malfunction at the Page Belcher Federal Building, located in Tulsa, Oklahoma. The building has 27 separate air handling units and 77 interior air supply zones, plus one to three perimeter air supply zones for each of the four floors and two mezzanines. One air-handling unit may serve from one to nine distribution zones. Low levels of airborne polychlorinated biphenyls (PCBs) were found throughout the building. There appeared to be no specific location within the building for a concentration of these chemicals. The vapor phase of the contaminant was enriched with lower-chlorinated isomers relative to a source mixture on surfaces. Recommendations are offered for decontaminating the building and its ventilation system and for instituting a medical-surveillance program.

37676 **(PB—87-183570/XAB) In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio.** Heitbrink, W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 20 Jan 1984. 27p. (ECTB—144-11B). NTIS, PC A03/MF A01.

A study was made of the use of a Taunton Engineering Company (TECO) RTS-100 automatic bag opener and a bag compactor to empty carbon black, clay, and other material from bags and to charge the bagged materials into a mixer at an adhesives, coatings, and sealant division of 3M Company in Grove City, Ohio. The potential hazards associated with this operation are the exposure to airborne dusts generated through handling of the bags and the physical stresses arising from lifting the 50 pound bags manually. The study showed that the TECO RTS-100 automatic bag opener and its trash compactor did not create dust emissions, with the exception of the dust emitted at the inlet to the system.

37677 **(PB—87-183596/XAB) Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey.** Lenihan, K.L.; Sheehy, J.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1987. 10p. (ECTB—163-11A). NTIS, PC A02/MF A01.

The technology available to control hazardous substances in gallium arsenide applications is reviewed and evaluated in light of findings from a visit to the Microwave Semiconductor Corporation in Somerset, New Jersey. The facility has 500 employees, 64 in the gallium arsenide technical staff. Direct ion implantation or epitaxial growth, photolithography, plasma etching, and backside wafer processing are used at the facility to fabricate a gallium-arsenide wafer. Hazards exist primarily in the numerous solvents, acids, and gases employed in wafer production. These include chlorobenzene, methanol, methyl-ethyl-ketone, methyl-isobutyl-ketone, ammonia, and silane. The use of arsine gas will soon begin at the facility, which will also be hazardous to employees due to its extremely toxic properties. An environmental engineer tests for 70 hazardous chemicals in the work area, including hydrogen-fluoride, cyanide, phosgene, ammonia, formaldehyde, arsine, and phenol. The authors recommend the establishment of a program for air sampling to monitor arsenic levels and wipe sampling for arsenic surface contamination.

37678 **(PB—87-183604/XAB) Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington.** Apol, A.; Thoburn, T.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1986. 22p. (HETA—85-462-1748). NTIS, PC A02/MF A01.

An authorized representative of the Association of Western Pulp and Paper Workers requested an investigation be made of employee exposure to diethylenetriamine (DETA), hexamethylene-diisocyante (HDI), and other chemicals in use during the production of carbonless paper at the Boise Cascade facility in Vancouver, Washington. This facility makes paper from pulp and carbonless paper by applying the appropriate coatings to the paper. Possible exposures to biphenyl and butyl biphenyls, formaldehyde, phenol, and petroleum solvents were also investigated. Medical interviews were conducted with 65 employees. In four cases, pulmonary problems were determined that may have been related to past diisocyanate exposure. The authors recommend that workers with asthma sensitization be medically monitored and evaluated, and that contact and inhalation exposures be reduced by the use of personal protective clothing and increased ventilation.

37679 **(PB—87-184669/XAB) VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement.** Farmer, J.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1987. 77p. (EPA—450/3-81/003B). NTIS, PC A05/MF A01.

See also PB—84-237320.

Standards of Performance for the control of VOC emissions from Volatile Organic Liquid (VOL) storage tanks are being promulgated under the authority of Section 111 of the Clean Air Act. These standards would apply to all new and existing storage tanks having a capacity of 75 cubic meters or larger, which are to be used for the storage of VOL. The document contains a summary of the public comments on the proposed revised standards and the EPA's responses, as well as summary economic and environmental impact statements.

37680 **(PB—87-184701/XAB) Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut.** McManus, K.P.; Kominsky, J.R.; Cherniak, M.G.; McConnell, R.; Handke, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1986. 44p. (HETA—83-162-1746). NTIS, PC A03/MF A01.

A request was received from the United States Steelworkers to investigate possible health hazards related to employee exposures to beryllium, arsenic, lead, nickel, cadmium, and silver at Handy and Harman, Inc., located in Fairfield, Connecticut. Granulomatous lung disease was present in five employees of the refinery, four of whom had worked in the furnace area. The investigation did result in the confirmation that a health hazard from beryllium exposure has existed at this facility. Recommendations include the use of rubber gaskets on drums during blender and crusher unloading, redesign of ventilation hoods and their operation at sufficient velocity, the use of respirators in the melt room, and systematic medical examinations.

37681 **(PB—87-184925/XAB) Handbook for the review of excess emission reports. Final report.** Quarles, P.; Peeler, J.W. (Engineering-Science, Inc., Fairfax, VA (USA)). May 1986. 92p. NTIS, PC A05/MF A01.

The Handbook for the Review of Excess Emission Reports provides specific information and recommendations on procedures to review and analyze opacity and $SO_2$ excess emission reports (EER's) by air-pollution agencies. Chapter I presents basic information on the EER review process recommended by EPA. Chapters II and III provide more detailed instructions on how to review and summarize opacity and $SO_2$ EER's, respectively. The handbook includes detailed explanations of reason categories for exceedances and CEMS downtime which have been recommended for use by EPA for summarizing EER data. The handbook is designed to provide detailed instructions to the inexperienced reviewer. However, summaries of the recommended review steps and EER review forms may be useful to experienced reviewers. The illustrations and example EER review procedures are based on EER's from large fossil-fuel-fired boilers subject to EPA regulation under 40 C.F.R. Part 60, Subpart D. However, the general approach and forms may be easily adapted to other source caterories regulated by EPA or the States.

37682 **(PB—87-185187/XAB) Topical report on the meeting of the Gas Research Institute Indoor Air-Quality Research Advisory Committee. Final report, February 11-13, 1986.** Coerr, S.; Johnson, D.O. (Gas Research Inst., Chicago, IL (USA)). Feb 1986. 85p. (GRI—87/0015). NTIS, PC A05/MF A01.

The document presents the conclusions and recommendations of the February 1986 meeting of the Gas Research Institute's (GRI's) Indoor Air Quality Research Advisory Committee, which was formed to provide advice on research results to date as well as on the emphasis and direction of the GRI Indoor Air Quality Research Program. Conclusions and recommendations are presented on possible health-effects issues, exposure studies, risk assessment, and mitigation. Attachments provide an overview of the GRI program and summarize contractor presentations.

37683 **(PB—87-185575/XAB) Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington.** Apol, A.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1986. 16p. (HETA—86-037-1749). NTIS, PC A02/MF A01.

A request was made by the management of Lamiglas, located in Woodland, Washington to investigate possible hazards to employees from exposure to solvent vapors during the making of fibrous glass and graphite fishing rods. Personal breathing-zone and area air samples were analyzed for acetone, 2-butoxyethanol, butyl-alcohol, cyclohexanol, petroleum distillates, toluene, and xylene concentrations. Employee exposure to these substances ranged from 3 to 59% of the appropriate evaluation criteria. Local exhaust ventilation was provided where needed. Some cases of dermatitis had resulted in the past from skin contact with high-temperature-cure epoxy resin and epoxy glue used in rod building. Dizziness, lightheadedness and occasional headaches were reported by the coater, blank washer, silk screener, set up worker, and finisher. In addition, the silk screener experienced some throat and nasal irritation and occasional bleeding due to cleaning materials that are in aerosol form when used. Improved ventilation was recommended for specified areas, along with lowering of temperatures for hand-held equipment when possible. All solvent containers are to be clearly labeled and used only under safe conditions. Protective gloves with liners are to be worn. Use of machine rather than hand held knives was recommended for removing cork handles from rods in an effort to avoid carpal tunnel syndrome.

37684 **(PB—87-185609/XAB) Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1986. 16p. (HETA—86-403-1747). NTIS, PC A02/MF A01.

Management requested an evaluation of exposures to nitrous oxide, ethrane, and isoflurane in the surgical department at St. James Community Hospital, located in Butte, Montana. Air samples were collected and evaluated for ethrane content, at which time, five of the 13 samples were found to exceed the NIOSH evaluation criteria of 0.5 parts per million (ppm), being measured as high as 2.5ppm. Three of 13 isoflurane samples exceeded the criteria of 0.5ppm, with a maximum recorded concentration of 4.1ppm. Nitrous oxide content was determined in 20 breathing zone air samples; two showed concentrations exceeding the criteria of 25ppm. The health hazard was confirmed for exposure to ethrane, isoflurane, and nitrous oxide. It was recommended that anesthesiologists check slip connections and the high pressure nitrous oxide connections, as these are areas where high concentrations in the workroom air were noted. Continued maintenance of the flexible hose going to the ventilation system from the popoff valve should be instituted.

37685 **(PB—87-185625/XAB) In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio.** Sheehy, J.W.; Godbey, F.W.; Cooper, T.C.; Lenihan, K.L.; Van Wagenen, H.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 37p. (ECTB—152-18B). NTIS, PC A03/MF A01.

A study of possible asbestos exposure was undertaken at an Ohio Department of Transportation regional headquarters, where repairs and maintenance procedures are conducted for cars, trucks, and specialized equipment. Personal air samples were collected in duplicate on cellulose-ester membrane filters for the duration of a single brake job, or two hours, whichever was longer. Area air-samples were also collected. Personal air sample results for brake mechanics indicate that asbestos concentrations averaged less than 0.004 fibers/$cm^3$, with no samples above this level. Mechanics' exposure was well below the NIOSH recommended exposure limit of 0.1 fibers/cc. The authors conclude that use of a vacuum enclosure unit resulted in very low asbestos exposures and that the unit appeared to be an effective device for dust control. A follow-up evaluation is recommended during cold weather with closed doors.

37686 **(PB—87-185971/XAB) Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986.** Spicer, C.W.; Coutant, R.W.; Ward, G.F. (Battelle Columbus Div., OH (USA)). Dec 1986. 168p. NTIS, PC A08/MF A01.

Nitrogen dioxide ($NO_2$) is a pollutant of considerable concern with respect to indoor air quality. This study investigated the extent to which materials present in residences remove $NO_2$ from air. Laboratory experiments were carried out in two 1.64-cu m stainless steel and glass exposure chambers. Typical experiments involved exposure of materials to an initial concentration of 150 ppb $NO_2$ at 50% relative humidity for 12 hours. Thirty-five different materials of construction and consumer products were examined. The results suggest that many of the residential materials are significant sinks for $NO_2$. The rate of $NO_2$ removal is highly variable, depending on the specific material being examined. Some active materials chemically reduce $NO_2$ to NO, while others appear to adsorb the $NO_2$. Relative humidity can influence the rate and mechanism of $NO_2$ removal for some materials. The laboratory results are consistent with $NO_2$ removal rate measurements in actual residences.

37687 **(PB—87-186227/XAB) Bibliography on asbestos in schools.** (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). Feb 1986. 59p. (EPA/IMSD—86/001). NTIS, PC A04/MF A01.

See also PB—81-225823.

The bibliography contains references to information on asbestos in school buildings. The citations are organized by the format of the various references, including EPA reports, books, journals articles and regulatory citations.

37688 **(PB—87-187076/XAB) EPA (Environmental Protection Agency) adopts wetlands research plan.** Kentula, M.E. (Northrop Services, Inc., Corvallis, OR (USA)). 1986. 3p. NTIS, PC A02/MF A01.

Pub. in National Wetlands Newsletter, 14(Jul-Aug 1986).

The U.S. Environmental Protection Agency (EPA) in January 1986 adopted a Wetlands Research Plan which decribes the research necessary to assist the Agency in implementing its responsibilities relative to wetlands, including 404 of the Clean Water Act. Many of the products will assist EPA personnel in evaluating 404 permit applications. Research will be implemented to: assess the water-quality functions of wetlands; develop methods to predict the cumulative impact(s) associated with wetland loss; and improve the formulation and evaluation of mitigation projects.

37689 **(PB—87-187837/XAB) Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York.** Boiano, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Nov 1986. 29p. (HETA—86-277-1750). NTIS, PC A03/MF A01.

In response to a request from the nurse administrator of Project Orbis, Inc., New York, New York, exposures to anesthetics and ethylene oxide were evaluated aboard the aircraft used as a teaching eye hospital. Each mission involved about 20 staff members. Anesthetics included nitrous oxide, halothane, and isoflurane. Ethylene oxide was used for equipment sterilization. Breathing-zone and general air samples were collected, and analytical methods included gas chromatography, spectrophotometry, and adsorbent-based dosimetry. Recovery-room nurses were overexposed to nitrous oxide (up to 79ppm) and isoflurane (0.96ppm) from patients. The author concludes that anesthetic exposures are excessive, and ethylene oxide exposure is a potential risk. Recommendations include engineering controls to limit anesthetic exposure, and good sterilization work practices.

37690 **(PB—87-187860/XAB) Zinc/zinc oxide preliminary source assessment.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Apr 1987. 80p. (EPA—450/3-87/008). NTIS, PC A05/MF A01.

A preliminary source assessment of industries with zinc and/or zinc oxide emissions is presented. Brief descriptions of these industries and associated air-pollution-control equipment are presented. Zinc/zinc oxide emission data were primarily obtained from the National Air Toxics Information Clearinghouse. The Appendix presents zinc/zinc oxide emission data that were used in the Human Exposure Model. The Model is used by EPA's Pollutant Assessment Branch to evaluate health risks from various pollutants.

37691 **(PB—87-188108/XAB) Sources and evaluation of uncertainty in long-range transport models.** Schiermeier, F.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1987. 13p. (EPA—600/D-87/168). NTIS, PC A02/MF A01.

Pub. in Proceedings of the 16th NATO/CCMS International Technical Meeting on Air Pollution Modeling and Its Applications, Lindau, Federal Republic of Germany, April 6-10, 1987.

The American Meteorological Society, under joint sponsorship from the U.S. Environmental Protection Agency, the Atmospheric Environment Service, Canada and the Ontario Ministry of the Environment, Canada, convened a workshop in September 1984 to address an aspect of long-range transport modeling that has become a topic of considerable concern, that is, the quantification of uncertainty in long-range transport-model predictions and the implications of these uncertainties on formulations of control policy. A series of draft chapters provided a focus for discussion by 38 invited national and international experts in the areas of policy perspectives, methods for sensitivity and uncertainty analysis, and sources of errors and uncertainty in Eulerian, Lagrangian, and stochastic long-range transport models.

37692 **(PB—87-188546/XAB) Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio.** Lee, S.A.; Rondinelli, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1985. 19p. (HETA—85-306-1753). NTIS, PC A02/MF A01.

In response to a request from workers at the Timken Corporation, Canton, Ohio, an investigation was made of respiratory irritation, skin rashes, and headaches in machinists working in the roller bearing grinding area. Workers suspected the grinding fluid additive, Gulf-Agent-1688, as the cause. Total airborne particulate exposures were 1.6 to 2.6mg/cu m in grinding and 0.3mg/cu m in inspection, both below the OSHA limit of 5mg/cu m for mineral oil mist. Soluble-Oil-B and Gulf-Agent-1688 could not be successfully analyzed. No nitrosamines or ethylene oxide were detected. Reported headaches and respiratory, eye, and other symptoms were not significantly different between 102 grinding workers and 52 inspection workers. The authors conclude that exposure to the machine oil mist is not the cause of reported symptoms, although work conditions have changed since Gulf-Agent-1688 was introduced. Recommendations include substitution of the fluid, use of respirators and protective clothing or creams, personal cleanliness, and isolation of machines.

37693 **(PB—87-188744/XAB) Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio.** Reed, L.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 21p. (HETA—82-059-1752). NTIS, PC A02/MF A01.

Health hazards were evaluated in classes of the Art Academy of Cincinnati in response to a request from the academy. Possible exposures included inhalation and skin absorption of organic chemicals, airborne particulates, and noise. Total organic vapors in silk screening were reduced from 26.1mg/cu m during use of oil-based paints to 3.7mg/cu m after switching to water-based paints. In most classes, exposure to various organic compounds was not excessive, except in lithography, where perchloroethylene levels (2.0 to 2.4mg/cu m) exceeded NIOSH recommended Lowest Feasible Level, based on its potential carcinogenic risk. Quartz particulates in sculpture (up to 13.0mg/cu m) and woodworking (up to 53.6mg/cu m) exceeded the American Conference of Governmental Industrial Hygienists' limit of 10mg/cu m. Sculpture yielded time-weighted noise averages up to 102 A-decibels, above the NIOSH level of 85 A-decibels. The author concludes that a hazard did exist from excessive exposures to airborne particles and perchloroethylene in some classes. The author recommends using gloves, masks, water based paints, and ear protection and education on safety issues.

37694 **(PB—87-188785/XAB) Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan.** Anderson, K.E.; Melius, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 19p. (HETA—84-484-1754). NTIS, PC A02/MF A01.

In response to a request from the International Association of Fire Fighters on behalf of the Detroit Fire Fighters Association, Detroit, Michigan, a health hazard evaluation was made of respiratory symptoms and skin irritation in fire fighters involved in a large fire and explosion at a warehouse. Over 200 fire fighters from fire-fighting organizations in three communities were involved in the incident. Site runoff water contained chlordane and malathion in low parts per million; other samples were negative. Nose and throat irritation, cough, and shortness of breath were experienced by a large proportion of fire fighters following the fire, and in 14, 15, and 17 percent, respectively, symptoms persisted over 2 months. Symptoms were significantly associated with time spent at the scene and time spent in heavy smoke. Pulmonary function tests were abnormal in 14 cases, ten due to obstructive lung disease, three to restrictive lung disease, and one to a combination. The authors conclude that better protective equipment is needed for fire fighters at chemical fires. Recommendations include development of a hazardous-materials response team, and implementation of a routine medical surveillance program.

37695 **(PB—87-189445/XAB) Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota.** Almaguer, D.; Boiano, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 43p. (HETA—85-018-1759). NTIS, PC A03/MF A01.

A sugar-beet mill owned by the American Crystal Sugar Company (ACSCO) was evaluated for worker exposure to airborne contaminants during beet processing and welding fumes during facility maintenance, following a request from ACSCO management and the American Federation of Grain Millers International Union. Total and respirable dusts were measured in personal and general air samples, and personal welding filter samples were analyzed. Analytical methods included spectroscopy, x-ray diffraction, gravimetry, and chromatography. Quartz was detected in settled dust and high volume air samples; beet pulp was considered to be a potential health risk. Exposures in excess of the most stringent environmental criteria were found for calcium-oxide in lime kiln workers, formaldehyde in diffuser area workers, and total welding fumes, nickel, and iron-oxide during welding operations. Exposures to nickel and formaldehyde presented potential cancer risks. The authors recommend formaldehyde replacement, particulate containment, ventilation improvement, and use of appropriate respiratory protection.

37696 **(PB—87-189452/XAB) Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio.** O'Malley, M.A.; Mathias, C.G.T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 17p. (HETA—86-018-1758). NTIS, PC A02/MF A01.

In response to a request from Robbins and Myers, Inc., an investigation was made of a possible health hazard at its Moyno Products Division, Springfield, Ohio. A case of vitiligo, possibly related to working with rubber products in pump manufacture was identified by a dermatologist. Uncured and cured rubber was found to contain 2,4-di-tertiary-butyl-phenol (DTBP) (0.01 to 0.03%) and para-tertiary-butyl-phenol (too low to quantitate). This class of compounds has been associated with vitiligo. Medical survey and examinations revealed four cases of active vitiligo. Its presence was significantly associated with highest exposure to rubber. Rubber department workers had a 22-fold higher risk for the condition compared to other employees. Comparing the four observed cases with an expected 1.1 cases (Health and Nutrition Examination Survey) yielded a standardized morbidity ratio of 3.6. The authors conclude that exposure to DTBP in rubber is the cause of vitiligo in these workers. Recommendations include testing rubber samples for contaminants, modification of work practices, and medical screening of exposed workers.

37697 **(PB—87-189460/XAB) Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota.** Boiano, J.M.; Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 42p. (HETA—85-046-1763). NTIS, PC A03/MF A01.

Following a request from the American Federation of Grain Millers International Union and management of the American Crystal Sugar Company (ACSCO), employee exposures to airborne contaminants during beet processing and welding fumes during facility maintenance were determined at a sugar beet mill owned by ACSCO. Exposures in excess of the most stringent criteria were found for calcium oxide and calcium carbonate in lime kiln workers, sugar dust in sugar bin workers, insoluble hexavalent chromium and nickel during welding, total welding fumes in one case, and nickel during a metal coating spray process. Quartz was found in several settled dust samples and high volume air samples. Nickel and chromium exposure presented potential cancer risks. The authors conclude that workers were overexposed to calcium oxide, calcium carbonate, sugar dust, total welding fumes, hexavalent chromium, and nickel at this facility. Recommendations include particulate containment, ventilation, and respiratory protection where appropriate.

37698 **(PB—87-189478/XAB) Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota.** Boiano, J.M.; Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 42p. (HETA—85-043-1760). NTIS, PC A03/MF A01.

In response to a request from management of the American Crystal Sugar Company (ACSCO) and the American Federation of Grain Millers International Union, employee exposures to welding fumes during facility maintenance and to airborne contaminants during beet processing were determined at a sugar-beet mill owned by ACSCO. Exposures exceeding the most stringent environmental criteria were found for calcium carbonate and carbon monoxide in lime kiln workers and sugar dust in sugar bin workers. Beet pulp dust was considered a potential hazard based on its content of crystalline silica. Welding produced excessive exposures to total welding fumes, hexavalent chromium, nickel, iron-oxide, and calcium-oxide. Chromium and nickel posed potential cancer risks. The authors conclude that workers were overexposed to calcium carbonate, carbon monoxide, sugar dust, total welding fumes, hexavalent chromium, iron oxide, nickel, and calcium oxide fumes at this facility. The authors recommend dust containment, ventilation, respiratory protection, and correction of slipping hazards.

37699 **(PB—87-189486/XAB) Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report.** Heitbrink, W.A.; Todd, W.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 35p. (ECTB—154-10). NTIS, PC A03/MF A01.

A control technology study was carried out by NIOSH at the Rohm and Haas acrylic resins facility in Louisville, Kentucky, to examine the relationship between worker dust exposure and dustiness test results, and to determine if exposures can be estimated on the basis of material properties. Tests were done in the packaging room for KV-2 acrylic resin. Air sampling was done at three packaging locations and at a control location for background. Material properties of increasing fine content and decreasing particle size were correlated with increasing dustiness and dust exposure; the authors caution that particle cohesion may influence this relationship. The Heubach test was found to be superior to the MRI test. The authors recommend careful use of the regression-analysis data and suggest that predictions of worker exposure may only be valid under conditions identical to those of this study.

37700 **(PB—87-189494/XAB) Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey.** Mehta, M.; Liveright, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 12p. (HETA—86-477-1755). NTIS, PC A02/MF A01.

Following a request from the manager of the Cumberland County Home Health Aid Service, Bridgeton, New Jersey, the facility was investigated for hazards related to previous incineration of plastic hospital syringes. The syringes were composed of polypropylene and butyl rubber, and investigations were aimed at determining symptoms related to exposure to the pyrolysis products carbonmonoxide, formaldehyde, acrolein, and crotonaldehyde; other possible factors (dust, ventilation); and wipe samples. Observations revealed probable recirculation of pyrolysis products into office areas, as well as a significant dust burden. Initial symptoms reported involved respiratory and mucous membrane irritation. Continuing symptoms included throat irritation, eye irritation, and rhinitis. The authors conclude that, in spite of negative wipe tests, the workers have probably had continued exposure due to the adherence of irritants onto dust particles. Recommendations include removal of all unnecessary mobile objects and cleaning of remaining objects with a HEPA filtering vacuum, complete cleaning of the entire building with mild detergent, and removal of all materials stored there by the hospital, since their presence would be a continued source of production and dissemination of dust.

37701 **(PB—87-189502/XAB) Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota.** Boiano, J.M.; Almaguer, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 44p. (HETA—85-044-1761). NTIS, PC A03/MF A01.

Employee exposures to airborne contaminants during sugarbeet processing and to welding fumes during facility maintenance were evaluated at a sugar beet mill 2063) owned by the American Crystal Sugar Company (ACSCO), in response to a request from the American Federation of Grain Millers International Union and ACSCO's management. Personal and general air samples were collected and analyzed for several chemicals, total and respirable dusts, and metals and welding fumes. Methods included gravimetric analysis, chromatography, spectroscopy, and x-ray diffraction. Exposures in excess of the most-stringent criteria were found for calcium-oxide, coal dust, crystalline silica, sugar dust, and formaldehyde. Areas of greatest exposure included lime-kiln operation, coal handling, and storage-bin housekeeping. Recommendations include use of respiratory protection, dust and fume containment, and formaldehyde replacement.

37702 **(PB—87-189510/XAB) Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota.** Almaguer, D.; Boiano, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 42p. (HETA—85-045-1762). NTIS, PC A03/MF A01.

Employee exposures to airborne contaminants during sugarbeet processing and to welding fumes during facility maintenance were evaluated at a sugar beet mill owned by the American Crystal Sugar Company (ACSCO), in response to a request from ACSCO's management and the American Federation of Grain Millers International Union. During beet processing, personal breathing-zone and general air samples were collected and analyzed for several chemicals and total and respirable particulates of various dusts. Welding fumes were analyzed by inductively coupled plasma/atomic emission spectroscopy of personal filter samples. The following exposures were considered excessive by the most-stringent criteria: lime-kiln helper to total particulates; Weibul storage-bin housekeeper to sugar dust; diffuser operator and charger to formaldehyde; welders and cutters to total welding fumes and specific metals, particularly hexavalent chromium and nickel. High-volume air and settled-dust samples contained crystalline silica representing a potential hazard. Recommendations include improved particulate containment and ventilation, use of respirators where appropriate, and formaldehyde replacement.

37703 **(PB—87-189528/XAB) Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 12p. (HETA—86-348-1756). NTIS, PC A02/MF A01.

In response to a request from the owner of J'Leen, Ltd., Boulder, Colorado, an evaluation of exposures to lead in the copper and lead glazing art studio was carried out. Breathing-zone and general air samples were analyzed by NIOSH Method P and CAM 173, blood lead was measured by voltammetry, and free-erythrocyte protoporphyrin was measured photofluorometrically. Ventilation was found to be inadequate for removing airborne lead resulting from use of lead dust and furnaces. The author concludes that the high environmental lead levels present a health hazard, and recommends improved exhaust ventilation, continued use of ultrafilter respiratory protection, and education of new employees on clean work habits.

37704 **(PNL-SA—14768) Wet scavenging processes.** Hales, J.M.; Berkowitz, C.M.; Easter, R.C. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 19p. (CONF-870444—2). NTIS, PC A02. File Number DE87011146.

From 16. international technical meeting on air pollution modelling and its application; Lindau, F.R. Germany (6 Apr 1987).

This paper presents an overview of scavenging-calculation techniques coming into use at the present time and attempts to describe how research products generated in related scientific endeavors can be incorporated with the newer models for improvement of wet-removal calculations. The capacity for direct application of mechanistic information from a variety of sources is a distinguishing feature of the newer models and is an encouraging advancement in our ability to coordinate diverse research efforts for practical value in this area. Scavenging calculations for reactive pollutants tend to become mathematically involved, and the cursory presentation given in this paper should be recognized as introductory material only.

37705 **(STEV-FGT—87-1) Gasification of waste as fuel.** Torisson, T.; Groenqvist, S.; Toecksberg, B. (Statens Energiverk, Stockholm (Sweden)). 30 Jan 1987. 61p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752406.

The idea of the project is to gasify municipal waste and thereafter combust the gas during controlled conditions. Thus is should be possible to accomplish two important advantages compared with traditional incineration: - a controlled end combustion which should result in low emissions of dioxines and nitrogen oxides, - the binding of heavy metals in the ashes. A two MW prototype was designed to gasify wood chips and/or densified refuse-derived fuels (RDF). The produced gas was burnt off in a boiler without flue gas cleaning. The results indicate that emissions can be easier controlled when the gasification stage is introduced. Documented emissions refer to test runs with a fuel mix consisting of 40 percent of wood chips and 60 percent of densified RDF. Measured NOsub(x) levels were in the range of 166-207 ppm and SO/sb2/ levels were in the range of 31-11 ppm. Dioxine emissions were measured to an average of 3.3 ng per nm/sp3/. The leachability of

metals from the ash was moderate except for cadmium and zinc. The calculated system efficiency from fuel to steam was 55 to 60 percent. The total investment cost for the gasifier prototype was approximately 1 MSEK with a calculated output of 3 MW. With consideration to the limited time for the testing of the prototype it can be said that: - gasification of densified RDF is possible. According to the measurements the emissions of NOsb(x), SO/sb2/ and dioxine can be expected to be low or moderate, - a large quantity of the heavy metals are bound to the ash. Exceptions are cadmium and zinc. Mercury was found in very small quantities in the ash, - the technical problems can probably be eliminated, - the system approach has possibilities to become commercial if the flue gas cleaning proves to be unnecessary.

37706 **(UCRL—15916) Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS).** Merry, M.H. (Lawrence Livermore National Lab., CA (USA)). Aug 1986. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011348.

Basic procedures and references are given for the operation of meteorological sensing instrumentation, data depiction and analysis systems for the Edgewood Arsenal, located on the next peninsula west from the Aberdeen Proving Ground site near Baltimore, Maryland. Site topography and climatology, sensor configuration, calibration, and data depiction and reporting procedures for the monitoring system are presented for compliance with applicable environmental regulations of US Federal Government and the State of Maryland.

37707 **Sensor array for toxic gas detection.** Stetter, J.R.; Zaromb, S.; Penrose, W.R. (to Dept. of Energy, Washington, DC). US Patent 4,670,405. 2 Jun 1987. Filed date 2 Mar 1984. vp.

A method is described for identifying at least one component in a gas sample, comprising the steps of: introducing a gas sample suspected of containing at least one component to an array of sensors for exposure of the component or a derivative thereof to the sensors. The array includes plural sensors having differing electrical responses to at least one component of the derivative thereof dependent on the chemical interaction of at least one component or the derivative thereof with each of the sensors and also dependent on operational condition of at least one of the sensors. An instrument is described for identifying and estimating the concentrations of components in a gas sample.

37708 **Problems and progress associated with the disposal of hazardous chlorinated chemical wastes.** Gupta, A.K. (The Combustion Lab., Dept. of Mechanical Engineering, Univ. of Maryland, College Park, MD). pp 75-84 of Management of energy technology, 1987. Dyes, O.; Harhalakis, G. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870210—).

From 10. energy sources technology conference and exhibition; Dallas, TX, USA (15 Feb 1987).

This paper describes the magnitude of the problem and the recent advances made for the disposal of hazardous wastes. Special attention is given to the chlorinated hydrocarbons since they constitute a major portion of the wastes produced. The study reveals that the amount of wastes produced is vast and is steadily increasing. Various methods of hazardous waste management, including incineration, are discussed. Thermal destruction by incineration is an attractive method for the volume reduction and ultimate disposal of wastes, while retrieving energy and producing power. Polychlorinated dioxins are primarily formed during combustion in practically all types of combustion systems ranging from wood stoves to municipal and industrial waste incinerators.

## 5003 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 36550, 36555, 36832, 37586, 37820, 37905*

37709 **(BNL—39456) Radon source rate measurements using multiple perfluorocarbon tracers.** D'Ottavio, T.W.; Dietz, R.N.; Kunz, C.; Kothari, B. (Brookhaven National Lab., Upton, NY (USA); New York State Dept. of Health, Albany (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870853—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008198.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In all passive monitoring system utilizing α-track detectors for radon and perfluorocarbon tracer (PFT) samplers for ventilation has been used to measure radon entry rates for 60 homes located within four separate areas of New York State (USA). Each home was divided into two or three zones so that multiple PFTs and multizone mass balance models could be used to compute zonal radon source rates. The whole house radon source rate for all 60 homes, averaged for a 2 to 7 week time period during the winter of 85-86, had a geometric mean of 4.94 Bq/s and an arithmetic mean of 10.0 Bq/s. Zonal mass balance equations applied to a tracer emitted in the soil outside 45 of the homes showed that, on average, 55% of the emitted tracer actually entered the houses. Diffusion alone cannot account for such a high value.

37710 **(ISH—99) Results of the activity measurements after the reactor accident in Chernobyl.** Winkelmann, I.; Endrulat, H.J.; Fouasnon, S.; Gesewsky, P.; Haubelt, R.; Klopfer, P.; Koehler, H.; Kohl, R.; Kucheida, D.; Mueller, M.K. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Sep 1986. 136p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06474.

The results of the gamma spectrometric analyses of particulate- and iodine filter samples for the period from the April 30, until the beginning of June 1986 are given in detail. As this time the major activity was due to tellurium-132 and iodine-132. In these measurements the contributions from particulate, gaseous elemental and organically bound radioiodine were determined separately. Radiochemical assays for strontium-89 and strontium-90 were carried out for the period from April 29 to May 11, 1986. The activity concentration of cesium-137 in air was 100 times higher than that of strontium-90. For tritium (as HTO), a doubling of the activity in rainwater could be determined for the time period from April 28 up to May 5, 1986. Furthermore the results of nuclide specific measurements of the soil contamination using an in-situ-spectrometer are given.

37711 **(LA—10992-ENV) Environmental surveillance at Los Alamos during 1986.** (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 303p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87010215.

This report describes the environmental surveillance program conducted by Los Alamos National Laboratory during 1986. Routine monitoring for radiation and radioactive or chemical materials is conducted on the Laboratory site as well as in the surrounding region. Monitoring results are used to determine compliance with appropriate standards and to permit eartly identification of potentially undesirable trends. Results and interpertation of data for 1986 cover: external penetrating radiation; quantities of airborne emissions and liquid effluents; concentrations of chemicals and radionuclides in ambient air, surface and ground waters, municipal water supply, soils and sediments, and foodstuffs; and environmental compliance. Comparison with appropriate standards, regulations, and backgound levels provide the basis for concluding that environmental effects from Laboratory operations are insignificant and do not impact the public, Laboratory employees, or the environment. 52 refs., 32 figs., 117 tabs.

37712 **(LBL—23136) The impacts of balanced and exhaust mechanical ventilation on indoor radon.** Fisk, W.J.; Mowris, R.J. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 13p. (CONF-870853—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009164.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Models for estimating radon entry rates, indoor radon concentrations, and ventilation rates in houses with a basement or a vented crawl-space and ventilated by natural infiltration, mechanical exhaust ventilation, or balanced mechanical ventilation are described. Simulations are performed for a range of soil and housing characteristics using hourly weather data for the heating season in Spokane, WA. For a house with a basement, we show that any ventilation technique should be acceptable when the soil permeability is less than approximately $10^{-12} m^2$. However, exhaust ventilation leads to substantially higher indoor radon concentrations than infiltration or balanced ventilation with the same average air exchange rate when the soil permeability is $10^{-10} m^2$ or greater. For houses with a crawl-space, indoor radon concentrations are lowest with balanced ventilation, intermediate with exhaust ventilation, and highest with infiltration.

37713 (LMF—115, pp 20-24) **Diffusivity study of free thoron decay products by deposition measurement on cylindrical tubes and screens.** Su, Y.F.; Newton, G.J.; Cheng, Y.S.; Yeh, H.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Knowledge of the diffusion coefficient of thoron decay products is necessary for assessing the radiation exposure resulting from exposure to thoron and its decay products. The diffusion coefficient of thoron decay daughters was measured using two independent systems. A sampling train consisting of a diffusion tube and a screen-type diffusion battery was used for the study under different relative humidities (RH) and flow rates. For RH between 35% and 85%, results of two systems are in agreement. The diffusivity of $^{212}Pb$ (ThB) was 0.036 +/- 0.002 $cm^2$/sec and 0.037 +/- 0.004 $cm^2$/sec for tube and screen penetrations, respectively. In dry air (RH < 30%) a linear relation between diffusivity of ThB and humidity was observed. 4 references, 3 figures.

37714 (LMF—115, pp 58-61) **Performance of continuous air monitors based on alpha spectroscopy in a dusty environment.** Seiler, F.A.; Newton, G.J.; Guilmette, R.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The performance of continuous monitors for airborne alpha emitters in a dusty environment is calculated using a time-dependent approach. Particular attention is given to the contribution of radon progeny to the count-rates in a single channel analyzer centered on the plutonium alpha lines. Count-rates, accumulated counts, alpha spectra, and time to false alarm due to radon progeny activity are calculated. The results indicate that for normal levels of radon progeny in the surface air used for ventilation, salt concentrations well below 1 $mg/m^3$ are needed near the monitor to guarantee proper functions. As higher concentrations will be found in the WIPP due to continuous mining, the proper performance of monitors based on alpha spectroscopy is in doubt. 2 references, 4 figures.

37715 (LMF—115, pp 62-65) **Source strength of thick, continuously deposited alpha sources.** Seiler, F.A.; Newton, G.J.; Guilmette, R.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

In the presence of sizable amounts of background aerosols, detection and quantitation of airborne alpha emitters becomes difficult. The interaction of alpha particles with the material of the background aerosol in the source leads to a deterioration of alpha spectra and a saturation of count rates. As stopping powers and ranges for alpha particles are not well-known for most substances, a determination of the specific source strength and of the airborne radioactivity concentration is difficult and beset by considerable systematic uncertainties. It is shown here, that for emitters with a half-life long compared to the accumulation time of that thick source, simple relationships can be obtained for the source strength at saturation, and thus also for specific activity of the source and the airborne activity concentration. 1 reference, 2 figures.

37716 (LMF—115, pp 66-68) **Evaluation of an L-shell X-ray based continuous air monitor for airborne plutonium for use in the waste isolation pilot plant.** Newton, G.J.; Guilmette, R.A.; Seiler, F.A.; Quindos, L.S.; Yeh, H.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

A continuous air monitor (CAM) for airborne plutonium was evaluated. The CAM is proposed for use in the underground Waste Isolation Pilot Plant (WIPP), a partially completed underground repository for transuranic wastes from national defense activities. The prototype CAM uses L-shell X-ray detection instead of alpha counting because of potential interferences by background aerosols consisting of salt dust and radon progeny. The CAM will provide a reliable alarm, in 4 h, for airborne $^{239}Pu$ at a concentration of $4.0 \times 10^{-11}$ $\mu Ci/cc$ (1.48 $Bq/m^3$), the MPC for insoluble $^{239}Pu$. Performance was also compared with an alpha-spectroscopy-based CAM of the type typically used by the nuclear industry in relatively clean environments. 2 references.

37717 **(PB—87-174876/XAB) Statistical aspects of autoregressive models in the assessment of radon mitigation.** Dunn, J.E.; Henschel, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Mar 1987. 13p. (EPA—600/D-87/085). NTIS, PC A02/MF A01.

The paper discusses statistical aspects of autoregressive models in the assessment of radon mitigation. Radon values, as reflected by hourly scintillation counts, seem dominated by major, pseudo-periodic, random fluctuations. A moderate degree of success in modeling these data is reported using relatively simple autoregressive-moving average models in order to assess the effectiveness of radon-mitigation techniques in existing housing. While accounting for the natural correlation of successive observations, familiar summary statistics such as steady-state estimates, standard errors, confidence limits, and tests of hypothesis are produced. The Box-Jenkins approach is used throughout. In particular, intervention analysis provides an objective means of assessing the effectiveness of an active mitigation measure, such as fan off/on cycle. Occasionally, failure to declare a significant intervention has suggested a diagnosis of the data-collection procedure.

37718 **(PB—87-174892/XAB) Resolving the radon problem in Clinton, New Jersey houses. Published paper, April-December 1986.** Osborne, M.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Mar 1987. 9p. (EPA—600/D-87/093). NTIS, PC A02/MF A01.

The paper discusses the resolution of a radon problem in Clinton, New Jersey, where significantly elevated radon concentrations were found in several adjacent houses. The U.S. EPA screened 56 of the houses and selected 10 for demonstration of radon-reduction techniques. Each of the 10 houses received an intensive radon diagnostic evaluation before a house-specific radon reduction plan was developed. Before and after the plans were implemented, radon concentrations were determined by charcoal canisters and continuous radon monitors. A variety of sealing and subslab depressurization techniques were applied to the 10 houses. Radon concentrations were reduced by over 95% in all 10 houses. Five meetings were held to explain to homeowners the radon reduction techniques being implemented and to answer questions of homeowners interested in applying similar radon-reduction efforts to their houses.

37719 **(PB—87-175006/XAB) Monitoring before and after radon mitigation.** Brennan, T.; Osborne, M.C. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1987. 14p. NTIS, PC A02/MF A01.

The paper discusses a radon reduction demonstration project in 1986 on 10 houses in Clinton, NJ. As part of this effort, radon was measured before and after radon-reduction techniques were applied. The purpose of the measurements was to ascertain the effectiveness of the radon-control methods being used. Since radon concentrations are normally highest in a depressurized house (commonly observed during cold winter months), efforts were made to emulate winter depressurization. Before radon-reduction techniques were applied, four houses were tested using a common window fan to induce 7 Pa of negative pressure. Results of these tests showed that fan-induced negative pressure has a dramatic impact on radon concentrations. For some houses, this technique was shown to adequately emulate winter-time radon entry rates during warm summer months. Potential problems that may cause this technique to fail in some houses were identified.

37720 **(PB—87-176426/XAB) Some results from the demonstration of indoor radon reduction measures in block basement houses. Report for June 1985-February 1987.** Henschel, D.B.; Scott, A.G. (American ATCON, Inc., Wilmington, DE). Mar 1987. 11p. NTIS, PC A02/MF A01.

The paper gives results of tests of active soil-ventilation techniques in 24 block-wall basement houses in eastern Pennsylvania having significantly elevated indoor radon concentrations, generally above 740 Bq/cu m. The results indicate that radon levels can be reduced substantially (often below the U.S. EPA guideline of 148 Bq/cu m) if effective suction can be drawn on the soil underneath the concrete slabs of these houses. Such effective suction appears achievable when either: (a) the house has a complete loop of drain tile around its footings for water drainage purposes, and suction is drawn on that loop; or (b) a sufficient number of suction pipes can be inserted at the proper locations into the crushed rock or soil underneath the slab.

37721 **(PB—87-186235/XAB) Bibliography on indoor radon pollution.** (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). May 1986. 115p. (EPA/IMSD—86/002). NTIS, PC A06/MF A01.

The bibliography contains references to information on the measurement and modeling of radon, mitigation of radon, health effects and contributing factors, effect of ventilation and energy efficiency on radon concentrations in buildings, and radon in water. It includes an appendix containing a list of contacts for further information on radon.

37722 **(PNL—6036) Design procedure for sizing a submerged-bed scrubber for airborne particulate removal.** Ruecker, C.M.; Scott, P.A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 68p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87009787.

Performance correlations to design and operate the submerged bed scrubber were developed for various applications. Structural design procedure outlined in this report focuses on off-gas scrubbing for HLW vitrification applications; however, the method is appropriate for other applications.

37723 **(RFP-ENV—86) Annual Environmental Monitoring report, January through December 1986.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 27 Apr 1987. Contract AC04-76DP03533. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011603.

This report documents the environmental surveillance program at the Rocky Flats Plant. The report includes an evaluation of plant compliance with all appropriate guides, limits, and standards. Potential public radiation dose commitments were calculated from average radionuclide concentrations measured at the plant property boundary and in surrounding communities. The radioactive and non-radioactive effluents from the Rocky Flats Plant meet the appropriate guides and standards and represent no measurable adverse environmental effects from the operation of the plant during calendar year 1986. The estimated potential radiation doses to the public from plant effluents are below Department of Energy and Environmental Protection Agency dose standards and are well below background dose levels experienced in this region from natural and other non-Rocky Flats Plant sources.

## 5004 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 37621*

37724 **(SIA—381/3) Heating days in Switzerland. Recommendation. Version 1982.** (Schweizerischer Ingenieur- und Architekten-Verein, Zurich). 1984. 26p. (In German). Schweizerischer Ingenieur- und Architekten-Verein, Zurich.

This recommendation is used to standardize the basis of calculation for averages over many years and was compiled based on the latest meteorological data. First, there is a report on the scope and terminology (general, definition and instructions for calculations, climatic regions), while in the next chapter, the average values over many years (selection of evaluation periods, average values over many years, heating degree days and heating days for other limits) are discussed. In the next two chapters, the HGT 20/12 for 'non-measuring stations' is determined (calculation of monthly/annual average temperature, determining the HGT 20/12 from the calculated average temperature) and conversion of the HGT 20/12 to other air temperatures and heating limits (for equal heating limit, conversion for any ambient air temperature and heating limits from 12 to 14/sup 0/C, conversion of HGT 20/12 to HGT 18/10 and HGT 22/14). In the appendix to the report, an example is given, a formula for calculations is shown and references are given to calculations. (HWJ).

## 5005 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 37688, 37855*

37725 **Tibet revisited: TIPMEX-86.** Reiter, E.R.; Sheaffer, J.D.; Bossert, J.E.; Smith, E.A.; Stone, G.; McBeth, R.; Zheng, Q. (Colorado State University, Fort Collins, Colo.). *Bulletin of the American Meteorological Society;* **68**: No. 6, 607-615(Jun 1987).

A long-planned field-measurement program to determine surface-energy budgets at two sites in Tibet was carried out during June 1986 in collaboration with scientists from the State Meteorological Administration, Academy of Meteorological Sciences, People's Republic of China. The data set obtained in Tibet is unique for this remote region of the world. The present report describes some of the experiences of the United States scientific team and its medical officer, M. Otteman of Ft. Collins, Colorado. The data are presently being archived on computer tapes. Preliminary analysis results are presented as typical examples of the conditions encountered at the two experimental sites near Lhasa (3635 m) and Nagqu (4500 m).

## 5006 Regulations

*REFER ALSO TO CITATION(S) 36959, 36960, 36961, 37637, 37650, 37681, 37857*

37726 **(PB—87-175568/XAB) NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report.** Piper, S.; Grant, M. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Dec 1984. 156p. NTIS, PC A08/MF A01.

This document presents the technical content of a workshop designed for training regulatory inspectors involved in enforcement of the asbestos NESHAP regulation, 40 CFR Part 61, Subpart M, dealing with the demolition and renovation of buildings containing asbestos materials. Information presented in this document covers health effects related to inhalation of asbestos, national EPA strategy, demolition and renovation regulations, asbestos in schools pro-

gram, OSHA requirements, safety equipment recommendations, legal issues of case development, inspection procedures and bulk sampling/analysis.

37727 **(PB—87-176871/XAB) Review of the national ambient air-quality standards for particulate matter: updated assessment of scientific and technical information. Addendum to the 1982 OAQPS (Office of Air Quality Planning and Standards) staff paper. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Strategies and Air Standards Div.). Dec 1986. 99p. (EPA—450/05-86/012). NTIS, PC A05/MF A01.

See also report dated Dec 82, PB—84-120401.

The paper evaluates and interprets the updated scientific and technical information that the EPA staff believes is most relevant to decision making on revised primary (health) national ambient air quality standards (NAAQS) for particulate matter and is an addendum to the 1982 particulate matter staff paper. The assessment is intended to help bridge the gap between the scientific review contained in the EPA criteria document addendum and the judgments required of the Administrator in making final deci .ons on revisions to the primary NAAQS for particulate matter that were proposed in March 1984 (49 FR 10408). The major recommendations of this addendum include the following: (1) The staff reaffirms its recommendation to replace TSP as the particle indicator for the primary standards with a new indicator that includes only those particles less than or equal to a nominal 10 um, termed $PM_{10}$; (2) Based on an updated staff assessment of the short-term epidemiological data, the range of 24-hour $PM_{10}$ levels of interest is 140 to 250 ug/$m^3$; (3) Based on an updated staff assessment of the long-term epidemiological data, the range of annual $PM_{10}$ levels of interest is 40 to 65 ug/$m^3$; (4) When selecting final standard levels, consideration should be given to the combined protection afforded by the 24-hour and annual standards taken together.

# 51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

*REFER ALSO TO CITATION(S) 37859*

37728 **(UCRL—96243) Numerical simulation of flow in Brush Creek Valley, Colorado.** Leone, J.M. Jr.; Lee, R.L. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 7p. (CONF-870864—7). NTIS, PC A02. File Number DE87010813.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

In this paper, we present some results from our three-dimensional, non-hydrostatic, finite element model applied to simulations of flow in Brush Creek Valley. These simulations are not intended to reproduce any particular experiment, but rather are to evaluate the qualitative performance of the model, to explore the major difficulties involved, and to begin sensitivity studies of the flows of interest. 2 refs., 11 figs.

## 5101 Basic Studies

*REFER ALSO TO CITATION(S) 38019*

37729 (CONF-8508235—, pp 117-121) **Multi-temporal Landsat data for detection and mapping of forest damage. Experiences from a test area in Schwarzwald, West Germany.** Boresjoe, L. (Stockholm Univ., Sweden. Remote Sensing Lab.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The aim of the study was to test the utility of Landsat MSS data to detect and map forest damage. The method chosen was to compare images from different years in order to find changes within the forested areas, which could be related to a known distribution of damage. Two images from the Fucino Station in Italy were used. During the analysis of data it could be stated that it was not possible to use the data set in a multi-temporal study, because it was impossible to get absolute calibrated data or detailed information about the processing of data from the Fucino Station. Also other parameters were different on the two occasions, which made it difficult to make an own calibration of the spectral bands.

37730 (CONF-8508235—, pp 123-128) **Small scale aerial IR-photographs for inventory of forest damage - experiences from Swedish test areas.** Holmgren, B.; Wastenson, L. (Stockholm Univ., Sweden. Remote Sensing Lab.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The possibility of interpreting the frequencies of needle loss on spruces in aerial IR-photographs has been tested in Sweden. By measuring spectral signatures from helicopter it has been demonstrated that there is a good correlation between needle loss and spectral reflection of spruce stands. This difference in spectral reflection makes it possible to interpret the frequency of needle loss in aerial IR-photographs on the negative scales 1/10,000 and 1/20,000. A comparison of the results from interpretation of aerial photographs from 1980 and 1984 has shown that within a test area at Toennersjoe in south western Sweden there was considerable damage on spruce trees as early as 1980.

37731 (CONF-8508235—, pp 129-134) **Mapping and health status assessment of the Flemish forests using remote sensing.** Roover, B. de; Dewispelaere, W.; Goossens, R.; Harrie, J. (Belfotop-EUROSENSE N.V., Wemmel, Belgium; Onderzoekscentrum voor Bosbouw, CEVA, Melle-Gontrode, Belgium). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

An operational methodology for forest mapping has been developed. The objective was to produce detailed maps linked to a forest management databank. The information, available in analogue (thematic overlays with a corresponding CIR-orthophotomap as base) and digital form (computermaps and -listings including area determination), is easily accessible and offers capabilities for further extension. The legend includes species composition, development stage, cover percentage and health situation. Remote sensing techniques based on CIR-photography have been chosen for this purpose because the old inventory method by questionnaires to be filled in by the owners proved to be unreliable especially for the numerous (70%) private forest holdings. Data acquisition was performed by Belfotop-EUROSENSE N.V. The remote sensing aircraft was equipped with a Daedalus DS 1240/1260 digital multispectral scanner and with two metric Wild RC10-A cameras for simultaneous colour and CIR-photography. This remote sensing aircraft is commonly known as ERSAF-platform (European Remote Sensing Aircraft Facility). Digital MSS data were processed for supervised forest classification of a mixed coniferous/hardwood forest and for stress estimation of homogeneous pine stands.

37732 (CONF-8508235—, pp 217-222) **Method of inventorying and evaluating the state of water and soil conservation in artificial forest.** Nishizawa, Masahisa. (Kyushu Sangyo Univ., Fukuoka, Japan. Coll. of General Education). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In Japan, planted forests constitute 39% of total forest land and especially Fukuoka Prefecture 67% of private forests are artificial forests. Because of the long spell of dry weather in the summer of 1978, the treatment of artificial forests for water and soil conservation was an urgent necessity. Our research group of evaluating the social functions of forest is continuing study to clarify the effect of forests on water and soil conservation. The results of research for five years are introduced and a prediction system of both stand structure and ground floor including the crown model is described.

37733 (CONF-8608141—, pp 1-5) **New analysis of branches, boles, and roots for predicting historical changes in photosynthesis, respiration, and carbon allocation below ground.** Waring, R.H.; Oren, R. (Oregon State Univ., Corvallis). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Stand characteristics may stabilize sufficiently to allow historical analyses of canopy photosynthesis, maintenance respiration, and potentially even shifts in below-ground allocation using growth analyses on branches and stems. This approach may have particular value where climatic or atmospheric chemistry has changed during the time since a forest obtained a closed canopy. Analysis are now limited to trees with large amounts of sapwood to enable projections of previous canopies. New techniques for dating when ray parenchyma cells die and convert to heartwood are required before the approach can be extented to other types of trees. 4 references, 5 figures.

37734 (CONF-8608141—, pp 6-17) **Principles and practices of dendroecology.** Fritts, H.C. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Dendroecology is the application of dendrochronologically dated ring materials to ecological problems. Sound ecological research involves basic principles and practices that may be unfamiliar to some scientists. Topics described are 1) crossdating; 2) stratification, selection of site and averaging; 3) the signal-to-noise ratio and its importance; 4) standardization and time series analysis; 5) calibration; 6) verification on independent data; and 7) reconstruction. If a tree-ring study does not include dendrochronological dating, it is proposed that the study be called a ring study, a tree-ring analysis or some name other than dendroecology. 8 references, 2 figures.

37735 (CONF-8608141—, pp 18-25) **Red spruce diameter growth and Weibull functions for even-aged stand development.** Federer, C.A.; Hornbeck, J.W. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Weibull functions are used to describe the relation of stand basal area and stand density to stand age for even-aged red spruce forests. The annual mean radial and basal-area increments of the trees as a function of age follow algebraically. These expressions indicate that the recent decrease in regional red spruce growth may be a consequence of an aging forest. To obtain better growth or smoothing functions, the authors applied an equation for mean basal-area increment as a function of basal area to individual-tree chronologies. Denderochronologists should study further the relation of individual-tree growth to growth of the entire stand. 9 references, 3 figures.

37736 (CONF-8608141—, pp 26-37) **Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA.** Kim, E.; Siccama, T.G. (Yale School of Forestry and Environmental Studies, New Haven, CT). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Synchrony of tree growth occurs among co-occurring species at similar elevations on the Green mountains in Vermont and on the White Mountains New Hampshire, showing that regional- or macro-environmental factors affect the patterns of tree growth over a wide area. At Hubbard Brook, using daily mean temperature measured for 24 years and daily soil moisture content simulated with a hydrological model, BROOK, some independent variables other than annual and monthly average temperature and total annual and monthly precipitation were defined and tested against tree growth indices of four species (white ash, beech, sugar maple, and yellow birch). These new variables explained more of the variation of species growth than those using the conventional variables, i.e., annual and monthly temperature and precipitation. The observed consistency by which the new variables explain the variation for all species showed that optimal growth potential occurs at normal environmental conditions and growth is reduced when the environmental conditions deviate from the normal. When there are strong within-season temperature fluctuations, or the dates of summer peak temperature and driest day in a year deviate widely from the normal, growth is greatly reduced. 7 references, 3 figures, 5 tables.

37737 (CONF-8608141—, pp 38-44) **Extended growth decreases in New England are limited to red spruce and balsam fir.** Hornbeck, J.W.; Smith, R.B.; Federer, C.A. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Trends in annual growth rates from 1900 to 1980 were determined for eight species by measuring ring widths on increment cores extracted from thousands of dominant and codominant trees throughout New England. Red spruce showed a steady increase in annual basal-area increment until about 1960, then a regionally consistent decrease in growth through 1980. Balsam fir showed a less marked decrease in growth rates beginning about 1970. Eastern white pine, eastern hemlock, red oak, red and sugar maple, and white ash showed generally increasing growth rates over the 80-year period. Decreasing growth rates for red spruce and balsam fir are not explained easily. Factors involved include defoliation by the spruce budworm, maturation of the forest, climatic change, unusual weather events, and atmospheric deposition. 15 references, 2 figures.

37738 (CONF-8608141—, pp 45-53) **Dendroecological approach for studying inter-tree competition.** Doyle, T.W. (Oak Ridge National Lab., TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045. Contract AC05-84OR21400.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The purpose of this research was to implement dendroecological techniques to investigate the nature and extent of inter-tree competition in a natural, mixed-aged, mixed-species forest. Sampling involved coring and mapping study trees and neighbors in a forest stand. Measurements of diameter, crown class and core orientation were taken along with tree azimuth and distance from plot center. Cores were crossdated and measured to determine age, sapwood basal area, ring width and basal area increment. A computer model recreated plot and tree configurations in order to calculate and test newly proposed competition measures as well as published indices. These indices were evaluated on their performance under different competitor selection criteria and assumptions. Analysis focused on competition and growth relationships as influenced by community structure and development, climatic conditions and species interaction. The study design, results and applications are discussed to emphasize the unique qualities of a combined dendroecological and model approach for studying competition. 19 references.

37739 (CONF-8608141—, pp 54-58) **Environmental factors involved in the growth and distribution of post oak in the southcentral United States.** Stahle, D.W. (Univ. of Arkansas, Fayetteville). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The gradual transition from eastern deciduous forests to the grasslands of the Great Plains coincides with a decline in mean annual precipitation. Two strong and independent macroclimatic signals are present in the annual ring series of post oak trees from this prairie-forest transition zone of the southcentral US. Post oak chronologies tend to become increasingly sensitive to climate variations westward toward the prairie border, particularly to growing season droughts. These trees also contain a unique and reasonably detailed record of frost damaged rings covering the past 300 years. Frost rings in post oak appear to be related both anomalous late-winter warming and a subsequent hard freeze, events which are appropriately known as False Spring. 7 references, 2 figures.

37740 (CONF-8608141—, pp 70-78) **Dendroecological analysis of a population of black gum (Nyssa sylvatic Marsh.) in southern Ontario, Canada.** McCaw, P.E.; Eckenwalder, J.E. (Univ. of Toronto, Ontario). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A significant stand of Nyssa sylvatica Marsh., Black Gum, in Backus Woods, southern Ontario, has been investigated in order to characterize the regeneration and growth ecology of this Carolinian tree-species. Black Gum occurs naturally in Canada only in extreme southern Ontario, where the north shore of Lake Erie forms the northern limit of its range. Backus Woods harbors a relatively large representation of Black Gum; the 6.7 ha study area contained a population of roughly 150 mature individuals within a spring-flooded swamp. The purposes of the project were to explain the conspicuous lack of Nyssa sylvatica regeneration within the population and to describe the growth dynamics of Nyssa sylvatica in this location. Increment cores were taken from each tree resulting in ring-width distributions revealing complex patterns of growth in the Nyssa sylvatica of this population. These patterns bore little relation to climatic history or life-long endogenous growth trends. High variation of ring-width distributions among individual trees reflected a complex of environmental and inherent controlling variables that could not be satisfactorily analyzed with any of the standard dendrochronological methods used. Consequently, the environmental conditions that favored establishment of the mature individuals in this population could not be reconstructed. 15 references, 2 figures, 1 table.

37741 (CONF-8608141—, pp 79) **Spatial distribution of light-ring years in subarctic Quebec.** Filion, L.; Payette, S. (Universite Laval, Sainte-Foy, Quebec). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Light rings are characterized by one or very few latewood-cell layers and they are particularly frequent in subarctic trees. Throughout the 1398-1982 A.D. chronology of light rings established in the Bush lake area, 65 years of light-ring occurrence were identified and 1593, 1816 and 1817 were years with the highest frequency. These diagnostic rings represent a useful cross-dating method, particularly for trees and krummholz with slow growth and low year-to-year growth variability. Low air temperatures occurring at the end of the growing season seem to initiate light-ring formation. The spatial distribution of these diagnostic rings from the tree-line to the Boreal forest, along a north-to-south transect, shows a decreasing incidence of light-ring frequency but indicates that the successive 1816-1817 light-ring years were frequent even in boreal trees; this suggest that summers were particularly cool during these years over northern Quebec. Additionally, the frequency of light-ring years along a maritime-continental transect was higher in continental sites compared to maritime sites near the Hudson Bay coast. This situation emphasized the influence of the maritime climate on the length of the growing season; higher frequency of light-ring years inland is associated with shorter growing season where frost incidence may occur in early August.

37742 (CONF-8608141—, pp 80-89) **Biological inference from growth-climate correlations in balsam poplar in Alaska.** Lev, D.J. (Univ. of Washington, Seattle). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Correlations between tree-ring growth and climate have been used to infer phenology and suggest testable hypotheses about the physiological ecology of balsam poplar (Populus balsamifera). Balsam poplar was studied at three locations spanning its latitudinal range in Alaska: high elevation sites in the Brooks Range and the Alaska Range and a low elevation site on the floodplain of the Chena River, near Fairbanks. Increment cores from each location were cross dated and measured. Standardized growth indices were correlated with climate data summarized by five-day periods. Timing of positive correlation were used to infer phenological events. Inferred dates of budbreak and initiation of growth period are similar at all locations. Bud set, however, is inferred to occur several weeks later at lower latitude sites than at high latitude sites. The longest growing period is inferred to occur at the low elevation site. Climate data and physiological literature are reviewed to construct hypotheses about how the species responds to environmental conditions. 13 references, 5 figures, 1 table.

37743 (CONF-8608141—, pp 90-100) **Modifications of the Adesmia horrida bushes due to snow weight at the Paramillo de Uspallata, Mendoza, Argentina.** Roig, F.A. (Laboratorio de Dendrocronologia, Mendoza, Argentina). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Heavy snowfalls are the cause of the destruction of Adesmia horrida Hook. et Arn. (Leguminosae-Papilionoidea) in the Paramillo de Uspallata, Mendoza, Argentina. Bushes were mainly affected between 1980-1984 corresponding to years of heavy snowfalls along the Andean range. A. horrida was destroyed on the shady slopes between 2700-2900 m asl. This did not happen on the sunny slopes due to greater insolation, less snow accumulation, faster melt, and a shorter loading time. In the studied area, A. horrida can spread over shady slopes until it develops thick bushes which are then wiped out because of changing snow precipitation. In this area, the advances and drawing back of the A. horrida spread on shady slopes coincides with the altitudinal limit of the species between 2700-3000 m asl. This does not occur on sunny slopes where the limit goes up to 3000-3200 m asl. 20 references, 4 figures, 2 tables.

37744 (CONF-8608141—, pp 101-118) **Forest disturbance and tree-ring analysis.** Brubaker, L.B. (Univ. of Washington, Seattle). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Disturbance shapes the characteristics of individuals, populations, communities and ecosystems. As evidence mounts that disturbance influences virtually all vegetation types and levels of ecological organization, its role as a selective agent and ecosystem process has gained theoretical importance. This paper examines the potential of tree-ring studies to characterize the frequencies and effects of three major classes of disturbances: selective disturbances, gap-forming disturbances, and stand-initiating disturbances. 30 references, 15 figures, 1 table.

37745 (CONF-8608141—, pp 142-154) **Tree-rings and insects: the influence of cockchafers on the development of growth rings in oak trees.** Christensen, K. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Growth-ring curves for oak trees (Quercus sp.), showing a regular rhythm with minimum every third, fourth or fifth year are described. The phenomenon is explained as a result of defoliation of the trees by cockchafers (Melolontha sp.). 4 references, 9 figures.

37746 (CONF-8608141—, pp 155-162) **Fire history of lodgepole pine of Mt. San Jacinto, California.** Sheppard, P.R.; Lassoie, J.P. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The objective of this study was to determine the natural fire history of the lodgepole pine (Pinus contorta var. murrayana) forest of the Mt. San Jacinto State Park Wilderness, California. Specifically, the authors sought to determine the general intensity, return interval, and areal extent of natural prehistoric fires based on fire dates obtained from living, fire-scarred lodgepole pine trees.

37747 (CONF-8608141—, pp 163-174) **Fire and stand histories in subalpine forests on the Thredbo ski slopes, Koscuisko, National Park, NSW, Australia.** Banks, J.C.G. (Australian National Univ., Canberra). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A 200 year fire history was developed for the subalpine forests on the slopes above Thredbo village in the Kosciusko National Park. Evidence for fires in c.1926 and c.1900 was derived from the even-aged fire regenerated stands which dominate the slopes of Mt. Crackenback. Earlier fires were dated to c.1866, c.1830 and c.1790. from post-fire growth pulses in old growth trees from treeline island stands. This indicated a fire occurring on average once every 40 years with some stands fire-free for much longer periods, with the development of uneven-aged stands at the treeline and even-aged stands down slopes. Four of these five fire dates corresponded to periods for fires in similar stands elsewhere in the park e.g. at Schlink Pass and Bimberi Peak. No evidence was found for fire in 1939 or frequent fires during the cattle grazing and gold fossicking periods spanning 1860s to 1957. Maximum tree height growth for mid-slope stands was estimated to be 20m at 50-60 years. Resides fire, bark beetle damage was also seen as a potent determinant of tree age structure. 18 references, 4 figures, 2 tables.

37748 (CONF-8608141—, pp 175-179) **Fire frequency and old trees in the Southern Canadian Rockies.** Pruden, M.A.; Fryer, G.I.; Johnson, E.A. (Univ. of Calgary, Alberta). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In the Kananaskis valley, coniferous trees older than 400 years were exceedingly rare and were found only in high stress environments. These habitats had > 99% chance of going 450 years without a fire. This long fire interval was the result of low fire spread due to sparse ground and canopy fuels, low ignition probability and low fire intensity. In addition, high stress, low fire frequency stands were uneven-aged with low but continuous recruitment and constant mortality. However, low fire frequency and low competition in themselves did not ensure trees greater than 400 years old. The high stress that the site imposed on the conifers resulted in restricted height growth, small leaf area and discontinuous cambial growth. These traits reduced aging by maintaining a balance between extension and foliage growth and the transport capacity of the trunk and other skeletal parts of the tree. 10 references, 3 figures.

37749 (CONF-8608141—, pp 180) **Relative importance of snow avalanche disturbance and thinning on tree populations.** Johnson, E.A. (Univ. of Calgary, Alberta). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Avalanche return intervals on two snow avalanche paths in the southern Canadian Rockies were estimated from scarred trees and shrubs. The interval between avalanches increased exponentially down the path. The tree and shrub diameters at which avalanches could cause breakage were predicted using both the mechanics of large deflections in tapered beams and the resulting stem bending stress, and these predictions were confirmed by comparison to actual diameters at breakage on avalanche paths. Lodgepole pine (Pinus contorta) and Engelmann spruce (Picea engelmannii) bend when small, but are broken by avalanches when larger than ~ 6 cm in diameter at the base. Glandular birch (Beutal glandulosa) and willow (Salix glauca) never grew large enough to break. Breakage was a result of size rather than wood elasticity or strength. Avalanche mortality was estimated from q/sub A/(x-b) = 1 - (1-1/T)/sup (x-b)/ where x is the tree age, b is the age at which the tree can first break and T is the average return time for the path location. Thinning mortality was reconstructed from live and dead stems in two Engelmann spruce and one lodgepole pine population. Avalanche mortality of trees was more important than thinning mortality when the average interval between avalanches was less than 150 years. The shift from shrub to tree dominated growth-habit down the avalanche path occurred when the average interval between avalanches was more than 15 to 20 years.

37750 (CONF-8608141—, pp 181-185) **Development of old-growth Douglas-fir forests northeast of Mount St. Helens, Washington, following an A.D. 1480 eruption.** Yamaguchi, D.K. (Geological Survey). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Cross-dated ring counts on Douglas-fir (Pseudotsuga menziesii) stumps were used to reconstruct the early development of old-growth forests northeast of Mount St. Helens, Washington, following catastrophic forest disturbance by tephra fallout from a large eruption in A.D. 1480. In addition to documenting volcanic and other disturbances in forests near the volcano, this investigation tests the previously advanced hypotheses that distant seed sources, repeated disturbances, or competition from shrubs and hardwoods during stand development could have caused Douglas-fir to recolonize many sites in the western Cascade Range over 90-230 year periods 400-500 years ago. 5 references, 4 figures.

37751 (CONF-8608141—, pp 186-212) **Tree-ring analysis in the earth sciences.** Shroder, J.F. Jr.; Butler, D.R. (Univ. of Nebraska, Omaha). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Tree-ring dating of geologic and geomorphic phenomena is a method to extract temporal information from woody vegetation, and therefore is associated with geobotany, biogeochemistry, and phytogeomorphology which are used for analysis of other aspects of the plant-land interface. The most important cross-dating principle of dendrochonology has been further clarified and subdivided for dendrogeomorphologic use into six levels; careful counting, signature rings, larger samples, skeleton plots, simple curves, and statistics that are tabulated with five levels of study characteristics; timing precision, species character, inter-comparisons, chronology type, and response level. Recent advances have been made in plant succession and minimum age dating that further clarify the rates and manners by which plants colonize disturbed surfaces. Dendrogeomorphologic principles of process - event - response recently have been extended into many new geographic and some methodological areas as techniques are refined continually. Special emphasis of late has been on refined continually. Special emphasis of late has been on various catastrophic natural hazards such as floods, ice jams, slope failures, volcanism, and seismic events. 123 references, 1 table.

37752 (CONF-8608141—, pp 281-289) **Dating earthquakes along the San Andreas fault system in California.** Sheppard, P.R.; Jacoby, G.C. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In spite of all the various confounding factors, earthquake signatures have been correctly identified. It is therefore reasonable to expect that with careful sampling and analysis, other prehistoric events can be identified and dated using tree-ring analysis. The authors are currently concentrating their research effort in the vicinity of Wrightwood, a town that straddles the San Andreas fault. Several Jeffrey pine (Pinus jeffreyi) and ponderosa pine (Pinus ponderosa) samples were collected along with one of white fir and of incense-cedar Libocedrus decurrens). The average extent of the samples was back to around 1600, but one Jeffrey pine extended back to 1382; unfortunately this particular tree exists about 100 m off the fault and its tree-ring growth was quite complacent with no missing rings or unique growth anomalies. Most of the sampled trees are currently near homes or other developments, and tree growth since at least 1900 might reflect that disturbance. Most of the samples are dated and measured and some show effects of the known 1857 earthquake. Study of this known event is important in order to learn the various tree-ring characteristics that reflect earthquake events. Following this calibration, they hope to discover evidence of earlier disturbances, which might be attributed to earthquakes. 21 references, 2 figures, 1 table.

37753 (CONF-8608141—, pp 382-391) **Red spruce tree-ring density and growth decline.** Conkey, L.E. (Dartmouth College, Hanover, NH). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Montane red spruce densities from Maine, which relate well to climate over the length of comparable record, show evidence of an unusual decrease over recent decades, one that is not as marked in ring widths from the same trees. Investigation into the relationship of climate to recent density values indicates a distinct long-term changes; regressions between spring temperature and maximum density are significant and quite similar in the two time periods, 1899-1945 and 1946-84, but become non-significant and different in sign in 1965-84. Correlations between predictions of density from spring temperature and actual densities are largely high, positive, and significant until the mid-1960s, when they become markedly non-significant and very small in value. There is at this time no one clear reason for such an unprecedented change in the relationship between maximum density of red spruce and climatic conditions. 16 references, 3 figures, 1 table.

37754 (CONF-8608141—, pp 422-425) **Comparative studies on the annual ring pattern and crown condition of conifers (the Valais, Switzerland).** Kontic, R.; Winkler-Seifert, A. (Institute of Botany, Univ., Basel, Switzerland). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Three methods of forest damage assessment (annual ring analysis, terrestrial crown assessment, and interpretation of infra-red aerial photography) are compared. Used alone, the two methods of crown assessment provide only partial findings. Annual ring analysis supplies much information - on the history of forest damage, conditions of site and climate, and the current trend shown by the state of health of the trees - which is indispensable for the interpretation of the crown assessments. It's very much advisable to combine the three methods. 1 reference, 3 figures, 1 table.

37755 (CONF-8608141—, pp 426-429) **Urban dendrochronology.** Joos, K. (Holzlabor, Basel, Switzerland). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

While there is no doubt about the significance and the feasibility of ecological dendrochronology in forestry research, this same method is still hardly applied for examining municipal tree stocks although it could be practically used very well in just this field of research. It is of growing interest to register the vitality of trees, especially in town streets. Furthermore, one can examine the causal connections between individual stress factors and the growth of trees in city streets regarding quantity and quality. This information allows a realistic establishing of priorities when improving the quality of habitat and choosing appropriate wood. All in all, 1500 trees were examined in the streets and parks of two Swiss towns in 1983 and 1985.

37756 (CONF-8608141—, pp 430-442) **Factors affecting the growth response of ponderosa pine to prescribed burning.** Sutherland, E.K.; Covington, W.W. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In southwestern ponderosa pine forests, prescribed burning is used as a management tool to reduce fuel hazards and to thin overly-dense thickets of young trees. In the authors study of two sites in northern Arizona, they assessed the effect of fire on radial growth of ponderosa pine trees. The sites have similar climates, soils and habitat types, but different in management history. The first site, Chimney Spring, was previously undisturbed by logging. The other, Brannigan Flat, had been logged at least once, and thinned in 1974. Both sites were burned in 1976. Control and burned areas were sampled at both sites. Variables measured on each tree included height, crown base, diameter, and surrounding competition. Two increment cores per tree were taken, crossdated and measured using dendrochronological techniques. Competition was estimated using Spurr's point-density method. The distributions of height, crown length, crown base, and approximate pith age were compared between treatments at each site and between sites using the Kolmogorov-Smirnov test. Periodic area increments (PAI's) were calculated for the years 1974-1976, 1977-1979, 1980-1984. Average PAI was compared between treatments using t-tests. Using a series of linear regression, the set of all trees' PAI's were compared to change in competition due to burning, present competition, change in competition due to thinning (at Brannigan), crown base height and crown ratio. 34 references, 1 figure, 3 tables.

37757 (CONF-8608141—, pp 443-450) **Management effects in British tree-ring series.** Bridge, M. (City of London Polytechnic, England). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Problems in dating oak timbers from historic buildings led to a consideration of the effects of various traditional management practices on the growth of timber trees. An investigation of the ring-widths of mature oak standards shows that they experience a small, though measurable, increase in growth for a period of 9 years following the removal of their surrounding underwood by coppicing. These release cycles in individual trees are not sufficient to account for the lack of crossmatching in historic timbers. 7 references, 3 figures, 1 table.

37758 (CONF-8608141—, pp 522-542) **Disaggregation of tree-ring series for environmental studies.** Cook, E.R. (Lamont-Doherty Geological Observatory, Palisades, NY). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Signal extraction in tree-ring research is considered as a general time series disaggregation problem. A linear aggregate model for a hypothetical ring width series is proposed, which allows the problem to be reduced to the estimation and extraction of five discrete classes of signals. These classes represent the signals due to trend, climate, endogenous disturbance, exogenous disturbance, and random error. For each class of signal, some mathematical/statistical techniques of estimation are described and reviewed. Except for the exogenous disturbance signal, the techniques only require information contained within the ring width series, themselves. A unified mathematical framework for solving this disaggregation problem has not yet been explicitly formulated. However, the general applicability of ARMA time series models to this problem and the power and flexibility of state space modelling suggest that these techniques will provide the closest thing to a unified framework in the future. 53 references, 4 figures.

37759 (CONF-8608141—, pp 554-565) **Time-series analysis applied to tree-ring series.** Monserud, R.A. (Dept. of Agriculture Forest Service, Moscow, ID). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Box-Jenkins methods were used to analyze and describe the stochastic time-dependent structure of 33 tree-ring series from the dendrochronology literature. Significant autocorrelation was found in every series. This result implies that hypothesis tests (such as an analysis of variance) made with dendrochronological time series would be biased, for the standard assumption on the independence of the observations with respect to time would be violated. This autocorrelation problem was eliminated by fitting appropriate autoregressive moving average (ARMA) models to the time series and then performing all subsequent analyses with the ARMA residuals. This procedure (called prewhitening) was shown to be quite effective in synchronizing two series: most spurious cross-correlations were removed when prewhitened series were used, leaving only the strong cross-correlation for the time lag that puts the two series in synchrony. The mixed ARMA (1,1) process was the overall best choice for describing the time dependency persisting in the series. Standardization of the ring-width series into a ring-index series proved to be a useful and usually necessary step for producing a stationary time series. The results of this study were corroborated by Rose who independently analyzed 65 separate chronologies. 12 references, 4 figures.

37760 (CONF-8608141—, pp 566-578) **Some applications of the Kalman filter to tree-ring analysis.** Van Deusen, P.C. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Two applications of the Kalman filter to red spruce tree-ring data from the Smoky Mountains are made. In the first application, a time varying climatic parameter is estimated, which allows one to plot the level of responsiveness that the trees are showing to climate over time while simultaneously producing a common chronology. The second application involves use of tree-ring data to predict past climate. An alternative standardization procedure is also presented; it is model-based but requires no least squares fitting to individual tree-ring series. However, the standardization procedure and the Kalman filter are not tied together so that one can be used without the other. 11 references, 4 figures, 1 table.

**37761** (CONF-8608141—, pp 599-610) **Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects).** Tessier, L. (Laboratoire de Botanique historique et Palynologie, France). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The methodology presented here is based on 1) a model of the radial growth of several populations of a tree species using ARMA processes, 2) the construction of a master chronology maximizing the climatic signal-to-noise ratio, 3) the P.C. analysis of all the response functions representing the populations. The autecology of the tree species is determined through the analysis of the coherence of all these response functions. 21 references, 4 figures.

**37762** (CONF-8608141—, pp 611-621) **Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies.** Duever, M.J.; McCollom, J.M. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In most situations, dendrochronological techniques are superior to ring-counting techniques because of the accuracy of the resulting data. However, depending of the objectives of a particular study, ring-counting may be an acceptable, and in some cases, the only feasible approach. Both methods require considerable amounts of time and effort when done properly. Once an individual is familiar with the techniques and a species' ring characteristics, the only extra time required by either approach involves the crossdating procedure in dendrochtonology. For determining tree or stand age, crossdating will produce more accurate estimates particularly for older trees, but when using standard procedures, neither approach produces exact ages. Information on growth rates can be obtained with both approaches, but growth trends related to tree age must be removed or considered when comparing different individuals or sites. The value of ring-counting for identifying environmental changes or events decreases over time. Only very major environmental changes or events in the recent past are detectable with ring-counting techniques. 23 references, 1 table.

**37763** (CONF-8608141—, pp 622-629) **Variations of the standard error/mean index ratio on wetland sites.** Bowers, L.J. (Christian Brothers College, Memphis, TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The standard error/mean index ratio was used to detect differences in the growth of baldcypress (Taxodium distichum L. Rich.) growing on the adjacent but hydrologically distinctive sites in Louisiana. The differences detected are consistent with the current literature concerning wood production and seasonal flooding. 15 references, 4 figures.

**37764** (CONF-8608141—, pp 630-646) **Current status of X-ray densitometry.** Telewski, F.W.; Jacoby, G.C. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A review of progress in the methodology of x-ray densitometry shows many changes over the past twenty-one years since it was first applied to dendrochronology. Although some techniques vary, the common goal is to maintain precision in all aspects of sample collecting, processing, dating, and data acquisition. The majority of studies have focused on maximum latewood density and correlative comparisons with climatic data such as temperature or rainfall. There is still a great need to improve the knowledge in the area of environmental signals present in wood density. An integrated approach to wood density measurement and environmental effects on density is needed. Such an approach should include controlled experiments, closely monitored studies and analyses along environmental gradients. Such studies coupled with the volume of information available on wood density and cultural practices in the forestry literature will greatly improve the interpretation of density signals present in tree-ring series. 51 references.

**37765** **(DOE/SR/00870—40) Reclamation of borrow pits and denuded lands: Final report, September 1, 1976 to December 31, 1985.** Marx, D.H. (Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station). 1985. Contract AI09-76SR00870. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012148.

Since 1976, the five scientists in the Institute for Mycorrhizal Research and Development (IMRD) have outplanted and maintained over 80,000 experimental tree seedlings in 27 different field experiments. Information resulting from this research has immediate value in the management of forest stands and soils at the Savannah River Forest Station. Important points include dried municipal sewage sludge at a broadcast rate of 1/2 to 1 inch disked into subsoiled borrow pits will support growth of loblolly pine (container- and bare-root nursery-grown), sweetgum, yellow poplar, green ash, sycamore, sawtooth oak, and black walnut that is 3 to 5 times greater after 4 to 12 years than fertilizer plus lime treatments; sweetgum, an economically important eastern hardwood, can be artificially regenerated successfully by selection of proper seed source and by manipulation of certain nursery procedures, such as available phosphorus levels and vesicular-arbuscular mycorrhizal colonization of feeder roots needed to produce quality seedlings; the number of first order lateral roots on sweetgum, oak, walnut, loblolly pine, and longleaf pine appear to be under strong genetic control; and the quality and quantity of ectomycorrhizae on container-grown or bare-root seedlings of loblolly and longleaf pines have a highly significant effect on their field performance. 17 refs.

**37766** **(STF—21A85024) Wild-life studies in the Alta watercourse. Survey report for 1982-1984.** Toemmeraas, P.J. (SINTEF, Trondheim (Norway)). 27 Feb 1985. 42p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752499.

The report gives a survey of a 3 year study of the wild-life before the Alta watercourse regulation. 245 nests were registered along the distance from Sandia to Masi (53 km) belonging to 64 birds of prey and 45 crow populations. The birds of prey produce 268 youngs. The registrations in the reference area Reisa, revealed 19 birds of prey populations along a 23 km river stretch. The same bird species were registered as in the 53 km stretch but they had larger yearly fluctuations. The registrations of duck species resulted in 782 observations of 14 species of which 8 were nesting. 3 tables, 17 drawings.

## 5102 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 36423, 37584, 37602, 37621, 37821, 37840, 37841, 37893, 37956*

**37767** **(BNL—35667) The role of dry deposition in acidification of waters.** Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011301.

This report analyzes the process of the acidification of freshwaters via atmospheric dry deposition. The approach taken here concentrates on long-term processes, of the order of seasons or years. The primary source of data is measurements of "throughfall" composition, i.e., the chemistry of precipitation after it passes through the forest canopy. Since the throughfall and its corollary, stemflow are dilute solutions of the acidifying materials, both those

that were originally deposited dissolved in precipitation and those that were washed off tree leaves (or leached out), one cannot distinguish the origin of the materials found in these solutions. Sulfate is invariably higher in concentration in throughfall than in incident precipitation, especially near strong pollution sources; hydrogen ion concentrations can go either way. The throughfall and stemflow, as well as materials deposited as forest litter, make their way through the watershed into the lake or stream in question. This process has been characterized in this study by plots of watershed output vs input, where input is defined as the sum of materials passing through the forest canopy. These plots show defined families of data points, as opposed to previous characterization attempts using wet deposition input only, which showed essentially no relationship. Data from Europe and the Northeastern US fell along a line of sulfur output equal to about 60% of input. Data from other parts of the US (Tennessee and the Pacific Northwest) showed a relationship of sulfur output equal to about 30% of input. A similar data presentation for hydrogen ion showed a threshold, below which all the hydrogen input was retained within the watershed.

37768 (CONF-8508235—) **Inventorying and monitoring endangered forests.** Schmid-Haas, P. (ed.). (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf). 1985. 356p. (In English, French and German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

These proceedings contain the 73 lectures presented at the above mentioned conference. The main aspects they are dealing with are the following: The goal of inventories in monitoring endangered forests; monitoring tropical forests; forest inventories by remote sensing in the tropics; aerial photos and scanner data for forest damage inventories; forest damage inventory methods; yearring analysis and forest damage; combined forest inventory methods; statistical planning and analysis of forest damage inventories; and management planning in endangered forests by means of continuous forest inventories. Separate abstracts are prepared for 49 papers.

37769 (CONF-8508235—, pp 19-20) **Inventorying and monitoring endangered forests. Welcoming remarks.** Schmid-Haas, P. 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

37770 (CONF-8508235—, pp 29-33) **Is ecosystem theory a basis for the inventory and monitoring of endangered forest.** Jeffers, J.N.R. (Institute of Terrestrial Ecology, Grange-over-Sands, UK). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The report outlines the role of ecosystem theory in the survey and monitoring of endangered forests. Some necessary conditions for the design of monitoring systems and the feasibility of developing ecological information systems as a guide for the managers of endangered forests are shown.

37771 (CONF-8508235—, pp 41-44) **International monitoring - an achievable goal.** Lund, H.G. (Department of Agriculture, Washington, DC, USA. Forest Service). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The need to monitor the world's resources and environment is pressing. Many systems are available to monitor the earth's resources. Implementation on an international basis, however, is slow to develop. Barriers to implementation and suggestions for removing barriers are presented.

37772 (CONF-8508235—, pp 135-140) **Spectral signatures of damaged spruce stands measured from a helicopter.** Kleman, J. (Stockholm Univ., Sweden. Remote Sensing Lab.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The influence of needle loss on the reflectance characteristics of spruce stands was investigated. Spectral signatures were acquired from a helicopter over 41 spruce stands in southern Sweden and related to needle loss data, established through field checks. Data for pine stands and some other forest types are also presented as a reference. A handheld radiometer operating at the wavelength bands 0.56, 0.68, 0.80 and 1.6 μm was used. The irradiance was measured during flight. The spectral parameter most strongly correlated to the extent of damage was the IR/red ratio. A set of measurements of the angular dependence of the reflectance for spruce and pine stands is also presented. The reflectance of the pine stands was considerably less direction dependent than for spruce. The implications of this for acquisition of aerial photographs is discussed.

37773 (CONF-8508235—, pp 147-149) **Application of airborne digital multispectral scanner data and testing of spaceborne data for the evaluation of forest degradation.** Felten, V.; Giot, P.; Marechal, P. (Walphot S.A., Searing, Belgium; Louvain Univ., Louvain-la-Neuve, Belgium. Faculte des Sciences Agronomiques). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Since two years, research upon forest damages has been made in Belgium based on remote sensing techniques. Its goal is a qualitative and quantitative inventory of the Walloon forests. The purpose of this paper is to explain the methodology using the processing of airborne multispectral scanner digital data. This is based on the opposite reflectance response between damaged and healthy tree crowns in the red-orange band and the infrared ones. The obtainment of thematic maps presenting four alteration classes facilitates the foresters actions. Quantitative stand by stand results permit temporal damage evolution studies. On the other hand, spatial digital data processing research can be done with the help of the airborne scanner data. The different flight altitudes tested for the previous study precise shadow/crown reflectance interactions that make our airborne inventory method unsuitable for small ground resolution. The satellite (Landsat TM and soon SPOT) data classification is in its starting period. The first step procedure, species and ages stratification, has been done successfully. Health status examination is starting now.

37774 (CONF-8508235—, pp 151-154) **Present and future applications of remote detection.** Marechal, P.; Giot, P.; Felten, V. (Louvain Univ., Louvain-la-Neuve, Belgium. Faculte des Sciences Agronomiques; Walphot S.A., Searing, Belgium). 1985. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Since 1982, damages have been observed in Norway Spruce (Picea Abies Karst.) stands in Eastern Belgium. Two main symptoms are recognized: loss of needles which may be dramatic and chlorosis affecting parts of the whole crowns of individual trees. From a comparison of color and color infrared (C-IR) aerial photography, C-IR proved to be the best support for a tree-by-tree visual interpretation of the degrees of damage. The best compromise cost/degree of information seems to be for a scale of 1/5,000. Six damage classes are separated taking into account chlorosis and loss of needles and their localization in the crowns. The inventory of large forested areas is made by plot sampling after stratification of the stands against their ages. C-Ir diapositives digitalization is approached as a possible technique for computer assisted photointerpretation and cartographic display of the results.

37775 (CONF-8508235—, pp 155-159) **Problems concerning the French monitoring grid of forest decline.** Duplat, P. (Office National des Forets, 77 - Fontainebleau, France. Section Technique). 1985. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In France, the monitoring grid of forest decline is covering about 1/5 of the forest area, mainly in the North-Eastern part of the country. The present paper recalls in a few word: the definition of the observed sample, the principle of individual marks according to crown thinning of trees, the main results that are derived. It emphasizes three difficulties that weigh on the interpretation of results: - marking is not truly objective - the sample is 'frozen' along the time - the sample is not representative.

37776 (CONF-8508235—, pp 161-165) **Remote detection in forestry industry and the determination of damage from flue gases by aerial infrared thermography.** Erdin, K. (Istanbul Univ., Turkey. Faculty of Forestry). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Remote detection is continually increasing in importance for the forestry industry. Remote detection, especially also classical aerial-photograph interpretation, can only be used for the purpose of determining the developments of damage, the subject this paper deals with. It is to contribute towards the methodics of aerial-photograph interpretation and to the verification of the safety of the information obtained by means of infrared thermography. The test area were the forests in the surroundings of Murgul, a place in north-east Anatolia where a copper mine is being exploited. The area covers an extent of 15 kilometres in north-south direction and of 8 kilometres in west-east direction. In the test area there exist both pure conifer and leaf-tree stands and mixed stands. With the aid of a colour-measuring device, the state of health of the conifers and leaf-trees damaged by exhaust gases (SO/sub 2/) was to be ascertained. The device used for colour measurement was a MACBETH TD-102 densitometer.

37777 (CONF-8508235—, pp 167-169) **Colour infrared air-photointerpretation by hexagon-methods to detect forest decline in Northrhine-Westphalia.** Kuhl, W.-E. (Landesanstalt fuer Oekologie, Landschaftsentwicklung und Forstplanung Nordrhein-Westfalen, Recklinghausen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In Northrhine-Westphalia the terrestrial estimation of forest decline is supported by the interpretations of colour infrared air-photos. For this reason, an optical three phase interpretation system, the hexagon method, has been proven as practical. The system is based on a square screen overlay, fixed on the photo with a six armed star in each square center. At the end of every tract, the next tree has to be interpreted for its species, age, vitality and social situation within the stand. The interpretation and storage of the data is aided by a computer which can also help the research by correlation calculations. Beside these reasons for sample errors and misinterpretations theoretical considerations will be discussed.

37778 (CONF-8508235—, pp 171-176) **Towards forest stress detection with digitized color infrared imagery.** Meyer, P.; Staenz, K.; Itten, K.I. (Zurich Univ., Switzerland. Geographisches Inst.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

A first attempt was made to monitor forest damages using a digital three-band data set produced from scanning a color infrared aerial photograph. The applied computer assisted classification procedures involving a tree by tree approach consist of basically four steps, namely the digitizing of tree contour lines (polygons), the actual classification within these polygons, the accuracy test to determine the most frequent class within the polygons, and the filling up of the polygons with this particular class. The best result was achieved with a parallelepiped classifier involving six bands which include one of the original bands (red region), a textural band (standard deviation), and four bands produced with a principal component/color enhancement. With this method, in the average about 80 percent of the trees could be correctly classified within the given forest damage classes.

37779 (CONF-8508235—, pp 177-178) **Large-area inventory of forest damage by means of aerial infrared thermography on a scale of 1:9000.** Scherrer, H.U.; Oester, B. (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf, Switzerland). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Approximately a quarter of the territory of Switzerland covered with forest was in 1984 and 1985 surveyed by aerial infrared thermography on a scale of 1:9000. The methods used to evaluate the aerial photographs are described in this paper. As experience shows, large-area mapping of forest damage is an appropriate means in practical forestry, provides a fair overview of the local damage situation, and helps to plan measures at the forestry level. Moreover, the infrared aerial photograph remains a document that cannot be tampered with and can be very effectively used for public-relations work.

37780 (CONF-8508235—, pp 179-182) **Results of computerized multispectral scanning of forest damage.** Kadro, A.; Kuntz, S. (Freiburg Univ., Germany, F.R. Abt. Luftbildmessung und Fernerkundung). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Multispectral scanner data have been evaluated to find out the possibilities to identify and classify differently damaged classes in the forest vegetation in South-west Germany. The classification is based on the different reflectance properties of different vegetation classes in the visual, near and middle infrared of the electromagnetic spectrum. The data have been collected from different altitudes by aircraft and also from Landsat 5. This paper presents results of the spectral reflectance signature of different types of vegetation and examples of computer-aided classification of forest damages.

37781 (CONF-8508235—, pp 183-187) **Comparative damage classifications using scanner data from from different flight altitudes.** Kritikos, G.; Kuebler, D.; Herrmann, K. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., DFVLR, Wessling, Germany, F.R. Abt. Digitale Bildverarbeitung). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The comparison of area-wise performed damage classifications from different flight altitudes, using multispectral airborne scanner data taken of the test sites Northern Black Forest and Fichtelgebirge, is presented and discussed. Based on our former experience we tried to find conformities and differences of the classification results between the flight altitudes 1000 m and 3000 resp. 4000 m. Finally, these findings were compared with the results of sample aerial photointerpretation.

37782 (CONF-8508235—, pp 189-193) **Applicability of Landsat-4 Thematic Mapper data for forest classifications.** Mueller, E.; Itten, K.I. (Zurich Univ., Switzerland. Geographisches Inst.). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The purpose of this study was to investigate the utility of the Landsat-4 Thematic Mapper data for forest application. In particular, the main effort was directed towards the separation of different forest types using a test site near Zurich, Switzerland. The expected performance of the Thematic Mapper within the forestry context could be hardly achieved with the data set used, since a discrimination within a forest stand was difficult under the existing conditions. This is mainly due to the complexity of the forest structure and appearance, the spatial resolution of the Thematic Mapper (30 m), the insufficient data quality and the date of overflight (January).

37783 (CONF-8508235—, pp 197-199) **Survey to assess the effects of atmospheric deposition on forest vegetation.** Barnard, J.E. (Department of Agriculture, Research Triangle Park, NC, USA. Forest Service). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

There is concern in the United States that atmospheric pollutants may be effecting the health of the Nation's forests. This year the Forest Service in the U.S. Department of Agriculture, in cooperation with the U.S. Environmental Protection Agency, began research aimed at inventorying and assessing eastern forest conditions as they may be related to possible air pollution damage. The development of the program and some early outputs are discussed.

37784 (CONF-8508235—, pp 201-203) **Monitoring the growth and health of white pine in New Hampshire.** Barrett, J.P.; Eckert, R.T.; Cooke, R.R. (New Hampshire Univ., Durham, USA. Dept. of Forest Resources). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Techniques for monitoring the growth and health of white pine on 50 plots in New Hampshire are described. Analysis over a 20-year period indicate a somewhat declining, but a moderately high sustained growth at older ages. Six sample trees on each plot were elected for caliper measurements of diameter as a marked point on the tree bole, color photos of tree crowns, and sample foliage evaluation. Data will be analyzed in the future to detect decline in the growth and health of white pine.

37785 (CONF-8508235—, pp 205-208) **Approach and methodology for monitoring of the health of forests in Sweden.** Bengtsson, G. (Swedish Univ. of Agricultural Sciences, Umeaa. Dept. of Forest Survey). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The paper gives a review of a programme for 'Inventory description and analysis of forest damage' that was started by the Faculty of Forestry in 1984. Especially the first nation-wide assessment of defoliation in connection with the National Forest Survey is described. The great potential of a continuous national forest inventory to include new observations on short notice and with low marginal costs is demonstrated. The interpretation of results from an inventory of defoliation entails several problems. For instance it must be better defined what should be considered to be a damaged tree or stand and what is a 'normal' frequency of dead and damaged trees.

37786 (CONF-8508235—, pp 209-211) **Sampling for branch, tree and stand estimates of crown biomass.** Brister, G.H.; Shiver, B.D. (Georgia Univ., Athens, USA. School of Forest Resources). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Crown biomass studies have typically suffered from small sample sizes which tend to inflate sampling errors. Samples should always cover the range of ages, site qualities and stand densities present in the target population. Suggestions are presented for better sampling coverage of the population while keeping time and expense at reasonable levels. Appropriate estimators for branches, trees and stands are discussed.

37787 (CONF-8508235—, pp 213-215) **Observed tree diseases and forest damages in the Finnish National Forest Inventory.** Kuusela, K. (Finnish Forest Research Inst., Helsinki). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Tree diseases and forest damages were observed, but not registered in detail, in the first five National Forest Inventories (1921-1976) as a basis to determine the silvicultural quality of tree stands. In addition to this, a system to observe and register individual diseases and damages was adopted in the 7th Inventory (1977-1984). The aim was to survey by unbiased sample the occurrance of damages which were increased during the 1970's. Threat of airborne pollutants initiated a project to observe and monitor diseases and damages by permanent sample plots. Approximately 3,000 permanent plots will be measured in 1985-1986. Disease observations in the 8th Inventory (1986-) will be integrated with permanent-plot information.

37788 (CONF-8508235—, pp 233-235) **Cantonal surveys of forest disease to complement national programs.** Eichenberger, H. (Kantonsoberforstamt, Zurich, Switzerland). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In the canton of Zurich, different programmes were instituted in 1984 in addition to the investigations conducted by the Federal Government. To allow quantitative statements on the condition of the forest, recording of damage was done by the canton roughly along the lines of the SANASILVA programme, on all sample plots of the federal forest inventory (one sample per square kilometre or some 500 samples in the canton). After evaluation it can be said that a statement can be made on the degree of damage per tree species with good accuracy for the whole of the canton, and that results for larger regions are still satisfactory. In addition, correlations can be derived between the degree of damage and, for instance, data on sites and stands. Follow-up recordings are to reveal any alterations in the condition of the forest.

37789 (CONF-8508235—, pp 237-242) **Pilot survey for a European inventory of forest decline.** Hildebrandt, G. (Freiburg Univ., Germany, F.R. Abt. Luftbildmessung und Fernerkundung). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Pilot surveys for large-scale recording of forest damage are conducted in the summer of 1985, on behalf of the Commission of the European Communities, in France, Belgium and the Federal Republic of Germany. They are an element in the preparation of joint inventories of forest decline in the countries of the Community. The method of inventory is based mainly on aerial-photograph interpretation. It is described in this paper, together with details of the methodics used in the German area of inventory, the Black Forest.

37790 (CONF-8508235—, pp 251-254) **Austrian survey on forest condition.** Pollanschuetz, J. (Forstliche Bundesversuchsanstalt, Vienna, Austria). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In the Austrian survey on the conditions of forests, reliable recording of changes in the condition of identical sample trees is given priority over the assessment of the extent of territory affected by forest disease. 30 dominating or predominating specimens each of the different species of indicator trees were observed, distributed over some 2.200 permanent observation plots in the whole of the federal territory, whenever possible, another 20 trees of a second indicator species were permanently numbered. The following are considered to be indicator trees: spruce, fir, pine, beech and oak-tree as well as, in the meadows, hybrid poplars. Certain criteria of selection apply to the test stand and sample trees. Besides site and stand characteristics to be surveyed initially, individual tree characteristics are annually recorded for all sample trees between mid-July and the end of August, with the emphasis being placed on the evaluation of the condition of the tree-tops and the degree of thinning of the entire crown (crown condition). Allowance is made for the fact that the recording of such qualitative characteristics may carry a certain subjective element by appropriate assignment of personnel to the annual recording work. Moreover efforts are made to as far as possible limit such systematic deviations, representing per-

sonal recording errors of individual teams, by joint recording training and controls.

37791 (CONF-8508235—, pp 255-258) **Flexible system to monitor the health status of a forest.** Schoepfer, W. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau, Germany, F.R.). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Two special forest monitoring grids were created at an early date (long-term-observation areas and permanent-sampling areas), which provided an effective system to monitor the condition of health of forests. It was this first extensive monitoring network inter alia that triggered the rapid implementation of an inventory of the ecological effects of immissions for the whole teritory of the state of Baden-Wuerttemberg. Higher efficiency of forest monitoring can be achieved by improved coordination of the timing of the individual elements of the inventory. This holds true especially of the choice of the date for a large-scale repeat inventory. The system of fixed yearly intervals between inventories must be replaced by a flexible one in which major and interim surveys can be carried through, as the development of disease in a forest system may require. For the annual interim surveys, two different procedures are being discussed both of which are possible from the viewpoint of the states of the Federal Republic of Germany: trend forecasts of the development of damage for larger landscape units from the long-term-observation plots, and computer projection of the damage portion of a sub-sample from the permanent-sampling areas via combined control and updating by a permanent inventory group. The combined method at the same time carries the advantage that control takes place on a uniform basis.

37792 (CONF-8508235—, pp 259-262) **Investigations performed on permanent observation plots established by the Forest Research Institute (FVA) of the State of Baden-Wuerttemberg.** Schroeter, H. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Stegen-Wittental, Germany, F.R. Abt. Waldschutz). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The development of the health condition of Norway spruce (Picea abies KARST.) and Silver fir (Abies alba MILL.) on permanent observation plots is presented. As an example the plots of two growth regions, Black Forest and Southwest German Alpenvorland are compared. Moreover the relationship between defoliation and the KRAFT tree classes 'predominant', 'dominant' and 'co-dominant' is shown for the spruce and fir collectives in these two growth regions. The results are shortly discussed.

37793 (CONF-8508235—, pp 263-267) **Inventorying and monitoring endangered forests in the People's Republic of Poland.** Smykala, J. (Naczelny Zarzad Lasow Panstwowych, Warsaw, Poland). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

For the first time, the extent and distribution of forest disease was objectively recorded at the level of the regional head forestry offices and for the whole country: an inventory of forest disease on a sampling basis (large-scale inventory) was carried through relatively rapidly without regard to the actual causes. The following criteria were important in the diagnosis and classification of the state of health of living trees: sociological position of trees, loss of needles, colour of needles, and form of the stem. Each criterion of evaluation corresponds to a certain number of points, and the following stages of vitality (stages of damage) are eliminated: I - healthy trees, II - sickly trees, III - sick trees, IV - dying trees. The wood of affected trees is grouped in corresponding categories. Moreover the types of living and dead trees (stems) are classified. To keep track of the further course of damage, the inventory will be repeated at bi-annual intervals - until a substantial improvement in the condition of the forest is noted. By setting up a grid of measuring points for air pollution, the authors wished above all to be able to make documented statements on emission effects.

37794 (CONF-8508235—, pp 273-276) **Integrated coverage of the condition of the forest. Multiple recording of data for an exemplary stand in Bavaria.** Traenkner, H. (Bayerische Forstliche Versuchs- und Forschungsanstalt, Muenchen, Germany, F.R.). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Forest disease has been monitored in Bavaria since 1983 via a permanent sampling grid, distributed over the entire territory of the state, which comprises 1667 test stands. Owing to this inventory it is possible to indicate what percentage of the total extent of forest has been affected by forest disease. Regional statements can be statistically corroborated only up to the scale of 'head forestry offices' and 'growth areas' as diagnostic units. For more subtle diagnosis in smaller forest areas, aerial surveying has been carried through in Bavaria since 1981. Intensive damage recording via aerial photograph evaluation and a host of terrestrial data from the most different sectors of science and the levels of the state forestry administration are combined. Also, it is possible to make differentiated and objectively verified statements for the partial area investigated not only on the extent and distribution of damage, but also on the type of damage and possible causal relationships.

37795 (CONF-8508235—, pp 277-280) **Standardized system for monitoring of air pollution effects on forests in the CSSR.** Vins, B. (Forestry and Game Management Research Inst., Prague, Czechoslovakia). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Air pollution damage on forests in Czechoslovakia appears already for nearly four decades. Influence of air pollution is one of main problems of forestry. Regional investigation into smoke injuries by means of permanent trial plots in the passed period was at the beginning of 80's enlarged by the introduction of the so called uniform system of air pollution influence monitoring on forestry. Individual levels of system are characterized inclusive possibilities of the use of remote sensing. An important criterion for the assessment of immission influence are production losses. Author discusses problems of studies of increment changes by means of tree ring analyses. At the present time it is obvious that it is necessary to undertake survey and monitoring of endangered forests on the whole territory of our country by means of representative methods.

37796 (CONF-8508235—, pp 283-285) **Trace element analysis of wood, a tool for monitoring air pollution.** Braeker, O.U.; McLaughlin, S.B.; Baes, C.F. III. (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf, Switzerland; Oak Ridge National Lab., TN, USA. Environmental Sciences Div.). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Measurements of tree ring widths and chemical analysis of nutrients, trace elements, and heavy metals in the wood of Pinus echinata growing in the Walker Branch Reservation, Oak Ridge, Tennessee reveal that changes have occurred in recent times, presumably due to environmental influences. However, the possible application of trees as bio-monitors by means of dating and documentation of changes in the chemical composition of their wood due to pollution requires further verification.

37797 (CONF-8508235—, pp 287-290) **On the application of dendrochronology for the evaluation of forest damage.** Eckstein, D. (Hamburg Univ., Germany, F.R. Inst. fuer Holzbiologie). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The application of dendrochronology for the evaluation of forest damage is considered. Hereby the exact dating of the under-

lying tree-ring series is emphasized. By means of a case study a specified dendroclimatological approach is illustrated.

37798 (CONF-8508235—, pp 291-295) **Abrupt changes in growth reflected in tree ring sequences as an expression of biotic and abiotic influences.** Schweingruber, F.H. (Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf, Switzerland). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Abrupt growth reductions in trees growing in areas with varying degrees of pollution in Switzerland are identified, and the onset and duration of the damage dated by means of pointer years. Onset and duration of both growth reduction and recovery vary from tree to tree and species to species. As a rule, the proportion of trees with reduced growth is higher in areas with heavy pollution stress than in those without stress. Tree ring patterns in all areas investigated, however, indicate changes beginning at the turn of the century at the latest and reveal a supra-regional pattern. Phases of reduction occurred in the 20s, 40s, and 70s, phases of recovery in the 30s, 50s, and 80s. In many cases, crown appearance and growth ring pattern give different pictures of the condition of the tree; trees with dense crowns may exhibit growth reductions in their ring pattern, while trees with sparse crowns may not. The relationships between tree growth and ecological factors vary according to tree species, site conditions, and region.

37799 (CONF-8508235—, pp 297-303) **Exemplary assessment of forest monitoring from air pollution. Analysis of diameter increase variations.** Suzuki, T. (Nagoya Univ., Japan. Dept. of Forestry). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Owase is a small town hidden in one of the Rias bays of the Kii peninsula, which is part of Honshu, the main Island of Japan. At the beginning of the sixties a big power station was constructed there and has been working since 1964. Before that there was a serious concern for the gas pollution of the forest, because Owase was one of the most famous wood producing districts in Japan. For the assessment of the pollution to the forest a committee was called up and has studied the problem for 20 years. This is a report of the main conclusions of its activities.

37800 (CONF-8508235—, pp 317-319) **Towards the integrated use of satellite data for forest inventories. A methodological perspective.** Poso, S. (Helsinki Univ., Finland). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Supervised classification commonly used in connection with satellite pictures often does not meet the information requirements of forestry planning. A method described here is an adjustment of double sampling for stratification. The method allows a flexible integration of various data sources and it is flexible in computing results for any regional or other subset of the first phase sample. Good flexibility indicates that the method is also applicable to the inventory and monitoring of environmental damages. The material consisted of 1472 field plots and their radiation values obtained from thematic mapper of Landsat 5. Data for accurate geographic location is important. Estimates of stand volume and age by the method was about equal to that obtainable from aerial photo interpretation.

37801 (CONF-8508235—, pp 339-342) **Problems in the planning of forest damage inventories.** Schlaepfer, R. (Eidgenoessische Technische Hochschule, Zurich, Switzerland. Inst. fuer Wald- und Holzforschung, Forsteinrichtung). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The aim and objectives of the forest damage inventories are presented. Some statistical problems concerning the variable 'Foliage loss', in particular the effect of the observer and the repeatability of the observation are discussed. The possible types of sampling units 'sample plot', 'point sample', 'sampling unit with constant number of trees' and 'sampling unit with concentric circles' are briefly compared. A way of analysing the efficiency of cluster sampling and of simple sampling is shown. The paper ends with some remarks concerning the determination of the sample size and an appeal to coordinate forest damage inventories with other work related with environmental problems.

37802 (CONF-8508235—, pp 343-344) **Use of logistic regression model in the statistical analysis of forest damage.** Mandallaz, D. (Eidgenoessische Technische Hochschule, Zurich, Switzerland. Inst. fuer Wald- und Holzforschung, Forsteinrichtung). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In order to perform a statistically thorough model checking we proposed a simplified binary classification (healthy versus nonhealthy) for the state of health, which was then used as the response variable of a logistic regression model with tree and environmental parameters as explanatory covariates. In several studies the model was of good predictive value and great flexibility. The most important tree factor appears to be the diameter, while other frequently significant factors (e.g. crown class, crown length, ph values, exposition, etc.) are more difficult to interpret since they show some variation from one inventory to another.

37803 (CONF-8508235—, pp 355-356) **Application of computerised systems to the nation-wide forest inventory in Denmark with emphasis on the possibilities of conducting inventory and monitoring of endangered forests.** Svendsen, T.B. (Ministry of Agriculture, Vejle, Denmark. Bureau of Land Data). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The nation-wide forest inventory in Denmark was started in 1979 and comprises mapping of forest boundaries, classification of forest regions, field inventories and collection of management plans. All results were analysed and stored by use of EDP at the Bureau of Land Data. The need for periodic updating of the nation-wide forest inventory, and the need for incorporating registration of the 'forest health status' were major reasons for the planning of a project which will analyse the possibilities for involving remote sensing (satellite images and aerial photographs) in future inventories.

37804 (CONF-8508235—, pp 367-369) **Control sampling for close-to-nature silviculture.** Egloff, H. (Forstamt Solothurn, Switzerland). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The aim of the management of close-to-nature mixed forest rich in different tree species is to produce high-grade heavy timber. Planning is based on the mapping of the forest actually existing and on permanent control samples. Between the periodical forest inventories, a basic measure taken with a view to the nursing or rejuvenation of individual stands is to measure the current circumferential growth of the test area trees and thus to check their vitality. In addition to the standardized evaluations by EDP, the catalogue of stages of vitality is established for each unit of evaluation. Furthermore the horizontal structure of stands is evaluated in some individual test plots, or the continuous increase in value calculated in sizeable-timber stands. These simple analyses with the aid of control samples increase the safety of forest management decisions.

37805 (CONF-8608141—, pp 360-371) **Characterization of historical growth patterns in declining red spruce trees.** LeBlanc, D.C.; Raynal, D.J.; White, E.H.; Ketchledge, E.H. (State Univ. of New York College of Environmental Science and Forestry, Syracuse). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The basic premise of this study is that the roles of natural determinants of tree growth must be explicitly evaluated before acidic deposition effects can be determined. The authors feel the first step in evaluating alternative hypotheses is a detailed characterization of the timing and nature of alterations in historical growth associated with red spruce decline. Accordingly, the objectives of their study include: 1) To determine if a pattern of specific changes in the growth patterns of red spruce, consistent across age classes and altitudinal gradients, is associated with the dieback of this species in the subalpine forest on White-face Mountain, New York. 2) To determine when differences in historical growth patterns that separate dead and dying red spruce form adjacent, apparently healthy trees became manifest in the growth chronology of these trees.

37806 (CONF-8608141—, pp 344-352) **Potentials and limitations of dendrochronology in pollution research.** Schweingruber, F.H. (Swiss Federal Institute of Forestry Research). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The basic principles of dendrochronological research as applied in the study of pollution are discussed and its weaknesses critically examined. The main source of error lies in faulty sample selection. Insufficient numbers of samples, genetically limited samples from heterogeneous sites, lack of reference material, and invalid averaging all lead to faulty results and incorrect interpretation. 14 references, 6 figures.

37807 (CONF-8704142—Summs.) **Environmental problems involved in the disposal of fly ash from waste incineration on waste dumps. Summaries.** (Deutsche Gesellschaft fuer Chemisches Apparatewesen, Chemische Technik und Biotechnologie e.V. (DECHEMA), Frankfurt am Main (Germany, F.R.)). 1987. 5p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752458.

From 337. DECHEMA colloquium on environmental problems induced by dumping of fly ash from waste incineration; Frankfurt am Main, F.R. Germany (2 Apr 1987).

Summaries of 4 lectures given at the meeting with the following topics: 1. Dioxins in fly ash; 2. Flue gas purification with treatment of residues for reducing pollutants; 3. Solidification of fly ash and its influence on the leaching behaviour; 4. Leaching of heavy metals from dumped residues.

37808 (DP-MS—86-149) **Transport of organic contaminants in coastal plain sediments.** Looney, B.B. (Savannah River Lab., Aiken, SC (USA)). Oct 1985. Contract AC09-76SR00001. 22p. (CONF-851027—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006390.

From 24. Hanford life sciences symposium on health and environmental research on complex organic mixtures; Richland, WA, USA (21 Oct 1985).

This work describes a model of organic transport in coastal plain sediments and discuss an application of the model to a specific site. The caveats and limitations of the model especially in terms of application to "complex organic mixtures" are outlined. The two primary caveats which require attention are observed sorbent concentration effects on distribution coefficient (K/sub d/) and the observed effect of organic cosolvents on K/sub d/. Neglect of these factors, as well as the scale effects in dispersion, may be responsible for poor estimations of the transport and fate of organic based on correlations from laboratory studies. 21 refs., 5 figs., 1 tab.

37809 (PB—87-173159/XAB) **Minimum-technology guidance on single-liner systems for landfills, surface impoundments, and waste piles - design, construction, and operation. Draft report 1982-85.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 24 May 1985. 62p. (EPA—530/SW-85/013). NTIS, PC A04/MF A01.

See also PB—87-151072.

The document presents the new requirements for interim-status waste piles applying to new units and replacements and lateral expansions on existing units. In addition, the existing single liner standards of 264.221(a), for surface impoundments, and 264.301(a), for landfills, still have applicability to portions of existing units that are not covered by waste at the time of permit issuance. The document identifies design, construction, and operation specifications that can be used by owners and operators in order to comply with the requirements of 264.221(a), 264.251(a), and 264.301(a).

37810 (PB—87-174884/XAB) **Soil-gas measurement for detection of subsurface organic contamination.** Kerfoot, H.B.; Barrows, L.J. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Mar 1987. 61p. NTIS, PC A04/MF A01.

The Lockheed Gas Analysis System (LGAS) grab-sampling method and the PETREX Static Surface Trapping Pyrolysis/Mass Spectrometry (SST-Py/MS) passive sampling technique for soil-gas measurement have been field tested at the Pittman Lateral near Henderson, Nevada. This site has unconfined ground water at 5 to 14 feet (1.5 to 4.3m) below the surface in alluvial fan sediments. Distinct chloroform and benzene/chlorobenzene contaminant plumes cross the site and have been delineated by repeated analyses of ground water from a line of boreholes spaced 200 feet apart. The LGAS technique successfully measured a chloroform soil-gas plume above the chloroform ground-water plume. The chloroform concentrations in soil-gas samples correlate well with ground-water concentrations. Further research is needed to establish which factors limit the survey precision.

37811 (PB—87-181939/XAB) **Superfund innovative technology evaluation (site) strategy and program plan.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response). Dec 1986. 57p. (EPA—540/G-86/001). NTIS, PC A04/MF A01.

Concern over the ability to fully characterize contamination at sites and the long-term reliability of containment technologies used for cleanup actions at Superfund sites is receiving much attention. At present, remedial actions usually consist of moving wastes to land disposal sites (which themselves may become Superfund candidates) or containing the waste in the ground onsite. In some cases, hazardous substances continue to be released to the environment. In response to these concerns regarding both characterization of sites and reliability technologies, the public and Congress are demanding that innovative and alternative technologies be used to effect permanent cleanups.

37812 (PB—87-183133/XAB) **Superfund federal-lead remedial project-management handbook. Final report.** Hooper, S. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Dec 1986. 204p. NTIS, PC A10/MF A01.

The handbook defines the roles and responsibilities of the Remedial Project Officer (RPM) with regard to Federal-lead remedial projects at uncontrolled hazardous-waste sites. It also discusses project management techniques and the resources available to the RPM for accomplishing his mission.

37813 (PB—87-183141/XAB) **Superfund state-lead remedial project-management handbook. Final report.** Winter, B. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Dec 1986. 131p. NTIS, PC A07/MF A01.

The handbook defines the roles and responsibilities of the Remedial Project Officer (RPM) with regard to State-lead remedial projects at uncontrolled hazardous-waste sites. It also discusses project-management techniques and the resources available to the RPM for accomplishing his mission.

37814 (PB—87-184578/XAB) **Superfund treatment technologies: a vendor inventory.** (Versar, Inc., Springfield, VA (USA)). Sep 1986. 540p. NTIS, PC A23/MF A01.

The document was designed to provide Superfund site managers, engineers and planners with the current information on the capability and availability of mobile-treatment units for Superfund waste. Increased use of these systems is becoming necessary as alternatives to land disposal are emphasized. The document contains descriptions and technical information on mobile-treatment units currently available or being built. This information was obtained from those companies known to have, or be in the process of developing, mobile treatment units. Mobile units under development

were reviewed if pilot-scale units were operating, or if the system would be commercially available in two to four months (six to eight months for thermal units). Additional companies may be added to the document periodically as new information becomes available.

37815 **(PB—87-185427/XAB) Treatment of landfill leachate at publicly owned treatment works.** James, S.C.; Schuk, W.W. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). 1986. 15p. (EPA—600/J-86/351). NTIS, PC A02/MF A01.

Pub. in Waste Management & Research, No. 4, 265-277(1986).

The project investigated the discharge of landfill leachate into a municipal waste-water collection system with subsequent treatment at the municipal treatment plant. This article points out that leachates from disposal sites can be mixed with municipal waste-water and treated by waste-water treatment plants using secondary aerobic treatment. Leachates are effluents, high in organic content and in many instances similar to industrial effluents. In order for a wastewater treatment plant to accept this type of effluent, the following conditions must be met. First, air supply and oxygen-transfer capacity must be sufficient to maintain aerobic conditions within the aeration basin with the increase in organic loads. Second, sufficient nutrient concentrations (especially phosphorus) must be observed in order to maintain necessary operating conditions.

37816 **(PNL—5751) Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document.** Van Voris, P.; Dawson, G.W.; Fredrickson, J.K.; Cataldo, D.A.; Rogers, L.E.; Novich, C.M.; Meuser, J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011629.

Methods for determining the nature and magnitude of injury to the following natural resources are described for: soil chemical characteristics (acidity or pH, cation exchange capacity, percent base saturation, salinity); soil physical characteristics (porosity, water holding capacity, aggregate stability); biological characteristics (microbial activities, invertebrate activities, vegetation); and contaminant transport potential (leaching, food chain). In addition, this document explains how injuries to the soil resource can be translated into a reduction in service provided by that soil and how to determine soil recovery potential. That portion of 43 CFR Part 11 that pertains to the soils portion of the geologic resource is explained.

## 5103 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 36525, 36539, 36547, 36549, 36550, 36551, 36799, 36816, 37436, 37710, 37723, 37826, 37905*

37817 **(BFE-R—86-04) Radioactivity in foods - Chernobyl and the consequences.** Diehl, J.F.; Ehlermann, D.; Frindik, O.; Kalus, W.; Mueller, H.; Wagner, A. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). Dec 1986. 95p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-07077.

From the time of the Chernobyl reactor accident until the end of November radioactivity data obtained on more than 36,000 food samples were reported by the country-wide network of measuring stations. An evaluation of the data is presented, together with results obtained at the Federal Research Centre for Nutrition on various foods collected in the Karlsruhe area. While I-131 constituted the main fraction of ingested radioactivity in May, this radionuclide reached the limit of detection in most samples in July. Since June the uptake of radioactivity was essentially determined by Cs-137 and Cs-134. Analyses of total diet samples indicated that the maximal uptake of radiocesium occurred in August, with a daily ingestion of 7.8 Bq Cs-137 and 4 Bq Cs-134 per person. Until December a decline to 2.2 and 1 Bq, respectively, was observed. From the total diet uptake in the calendar year 1986 an effective equivalent dose of 1.8 mrem, 1.3 mrem, and 0.30 mrem due to Cs-137, Cs-134, and I-131, respectively, was estimated.

37818 **(BMI/ONWI—638) Determination of background radiological characteristics within the Palo Duro Basin, Texas: Technical report.** (NUS Corp., Gaithersburg, MD (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Apr 1987. Contract AC02-83CH10140. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010245.

The National Waste Terminal Storage Program was established in 1976 by the US Department of Energy's predecessor, the Energy Research and Development Administration. In September 1983, this program became the Civilian Radioactive Waste Management (CRWM) Program. Its purpose is to develop technology and provide facilities for the safe, environmentally acceptable, permanent disposal of high-level waste (HLW). HLW includes wastes from both commercial and defense sources, such as spent (used) fuel from nuclear power reactors, accumulations of wastes from production of nuclear weapons, and solidified wastes from fuel reprocessing. The information presented in this report pertains to the background radiological characteristics studies of the Salt Repository Project of the Office of Geologic Repositories in the CRWM Program.

37819 **(CONF-8705132—1) A method to automate the radiological survey process.** Berven, B.A.; Blair, M.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009120.

From 4. annual meeting of the Southeastern Regional Health Physics Society chapters; Williamsburg, VA, USA (7 May 1987).

This document describes the USRAD system, a hardware/software ranging and data transmission system, that provides real-time position data and combines it with other portable instrument measurements. Live display of position data and onsite data reduction, presentation, and formatting for reports and automatic transfer into databases are among the unusual attributes of USRADS. Approximately 25% of any survey-to-survey report process is dedicated to data recording and formatting, which is eliminated by USRADS. Cost savings are realized by the elimination of manual transcription of instrument readout in the field and clerical formatting of data in the office. Increased data reliability is realized by ensuring complete survey coverage of an area in the field, by elimination of mathematical errors in conversion of instrument readout to unit concentration, and by elimination of errors associated with transcribing data from the field into report format. The USRAD system can be adapted to measure other types of pollutants or physical/chemical/geological/biological conditions in which portable instrumentation exists. 2 refs., 2 figs.

37820 **(DOE/ID/12584—5) Validation of the abbreviated Radon Progeny Integrating Sampling Unit (RPISU) method for Mesa County, Colorado.** Langner, G.H. Jr. (UNC Geotech, Grand Junction, CO (USA)). Jun 1987. Contract AC07-86ID12584. 76p. (UNC/GJ—34-TMC). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011230.

The US Department of Energy (DOE) Office of Remedial Action and Waste Technology established the Technical Measurements Center at the DOE Grand Junction, Colorado, Projects Office to standardize, calibrate, and compare measurements made in support of DOE remedial action programs. Indoor radon-daughter concentration measurements are made to determine whether a structure is in need of remedial action. The Technical Measurements Center conducted this study to validate an abbreviated Radon Progeny Integrated Sampling Unit (RPISU) method of making indoor radon-daughter measurements to determine whether a structure has a radon-daughter concentration (RDC) below the levels specified in various program standards. The Technical Measurements Center established a criterion against which RDC measurements made using the RPISU sampling method are evaluated to determine if sampling can be terminated or whether further measurements are required. This abbreviated RPISU criterion was tested against 317 actual sets of RPISU data from measurements made over an eight-year period in Mesa County, Colorado. The data from each location were tested against a standard that was assumed to be the same as the actual annual average RDC from that location. At only two locations was the criterion found to fail. Using the abbreviated RPISU method, only 0.6% of locations sampled

can be expected to be falsely indicated as having annual average RDC levels below a given standard.

**37821 (DP-MS—87-37) Risk assessment of soil contamination criteria.** King, C.M.; Marter, W.L.; Montaque, D.F.; Holton, G.A. (Savannah River Lab., Aiken, SC (USA); JBF Associates, Knoxville, TN (USA)). Jun 1987. Contract AC09-76SR00001. 25p. (CONF-8706136—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011179.

From AICHE division of health and safety meeting; Houston, TX, USA (4 Jun 1987).

Criteria have been developed to select radioactive and nonradioactive contaminants at waste sites detailed analysis and risk assessment. These criteria were based on soil and water quality guidelines developed by various government agencies to determine if the criteria were appropriate. We performed a risk assessment of a hypothetical site which contained radioactive and nonradioactive contaminants at levels equal to the criteria values. Risks to the public from atmospheric, surface water, and groundwater exposure pathways were examined. Health risks to the public from atmospheric releases of radioactive and nonradioactive materials from a waste at soil criteria contamination levels are low. Health risks to the maximally exposed individual to chemical carcinogens are considerably below traditional EPA action levels. And health risks to the maximally exposed individual to atmospherically released radioactive contaminants is $1.88 \times 10^{-7}$, more than a factor of 5 less than $10^{-6}$. Based on our atmospheric exposure pathways analysis and risk assessment, the applied soil criteria are appropriate for screening out unimportant risk contributors to human health from atmospheric exposure pathways. 13 refs., 3 figs., 7 tabs.

**37822 (SAND—85-0008) Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project.** Prindle, N.K.; Foster, J. (Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 83p. NTIS, PC E04/MF A01; 1; GPO Dep. File Number DE87012507.

TRACR3D is a computer code developed at Los Alamos National Laboratory to model three-dimensional fluid flow and mass transport in a porous medium. The code is being considered for use in performance assessment modeling of a potential repository for high-level radioactive wastes at Yucca Mountain in Nye County, Nevada. This report describes modifications made during the installation and implementation of the code at Sandia National Laboratories and the results of some test problems. The operating system commands necessary to direct TRACR3D on the CRAY-1 computer at Sandia are included, and a flow chart outlining the code structure is presented.

**37823 Carbon and isotopic mass balance models of Oasis Valley-Fortymile Canyon ground water basin, southern Nevada.** White, A.F.; Chuma, N.J. (Lawrence Berkeley Lab., CA). *Water Resources Research;* **23**: No. 4, 571-582(Apr 1987).

Environmental isotopes and carbon chemistry provide means of differentiating various recharge areas, flow paths, and ages of ground water in portions of the Nevada Test Site and vicinity. Regional $\delta D/\delta^{18}O$ trends are offset from the present-day meteoric line by a deuterium depletion of 5 per thousandth, suggesting paleoclimatic changes. Partial pressures of $CO_2$ and the $^{18}O$ and $^{13}C$ data indicate solubility and isotopic equilibrium between the gas and water in the soil zone with progressive exchange with underlying ground water in the shallow alluvium of Oasis Valley. Application of a closed system $CO_2$ model using the EQ3NR/EQ6 reaction path simulator successfully reproduces chemical compositions observed in the alluvium in the Amargosa Desert and in the deep tuff aquifer beneath Pahute Mesa and Yucca Mountain. Initial P/sub $CO_2$/ input to the soil zone during recharge was calculated to range from 0.03 to 0.10 atm, which is comparable to measured soil $CO_2$ pressures in Oasis Valley. Results are compared for $^{14}C$ ages using the $\delta^{13}C$ dilution correction and a mass action correction term relating predicted and calculated ionic activity products of $CaCO_3$. Results are generally comparable with discrepancies attributed to anomalous $\delta^{13}C$ values.

## 5105 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 36328, 36345, 36459, 36550, 37154, 37765, 37853*

**37824 (CONF-870297—1) Gas pressure and concentration gradients at the top of a landfill.** Bogner, J.; Vogt, M.; Moore, C.; Gartman, D. (Argonne National Lab., IL (USA); Geotechnics, Inc., Columbus, OH (USA)). 1987. Contract W-31109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011490.

From 10. international landfill gas symposium; West Palm Beach, FL, USA (9 Feb 1987).

Vertical gas pressure and concentration gradients are being investigated at the Mallard North Landfill (DuPage County, Illinois) using nests of probes installed in the top of refuse and at two depths in the clay cover materials. Soil gas pressures and atmospheric pressure are monitored continuously using electronic pressure transducers linked to a microcomputer. Concentrations of methane, carbon dioxide, nitrogen, and oxygen in the soil gas are determined using a field gas chromatograph. Supporting meteorological, soil temperature, and soil moisture data also are obtained. Based on data from the fall of 1985 and the spring, summer, and fall of 1986, soil gas pressures at all depths responded to changes in barometric pressure; however, the type of response varied, depending on soil moisture and temperature. During warm, dry weather, for example, soil gas pressures in the cover and the top of the refuse equilibrate rapidly with barometric pressure, indicating that diffusion is the major mechanism for gas transport at that time (no pressure gradients). The rate of diffusional flow depends on the properties of the cover materials, as well as the concentration gradients. Increases in soil moisture, in particular, decrease the gas-filled porosity of the cover materials and retard gas movement. Our results suggest that design and maintenance of tighter landfill covers should be considered at sites where gas recovery is anticipated, to prevent loss of methane and influx of oxygen.

**37825 (DP-MS—86-155) Remote sensing at Savannah River.** Corey, J.C. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 17p. (CONF-8611163—1). NTIS, PC A02. File Number DE87011175.

From Water and Pollution Control Association of South Carolina fall conference; Myrtle Beach, SC, USA (5 Nov 1986).

The paper discusses remote sensing systems used at the Savannah River Plant. They include three ground-based systems: ground penetrating radar, sniffers, and lasers; and four airborne systems: multispectral photography, lasers, thermal imaging, and radar systems. (ACR)

**37826 (DPST—85-704) F-Area Seepage Basins: Environmental information document.** Corbo, P.; Killian, T.H.; Kolb, N.L.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Dec 1986. Contract AC09-76SR00001. 245p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87011220.

This document provides environmental information on postulated closure options for the F-Area Seepage Basins at the Savannah River Plant and was developed as background technical documentation for the Department of Energy's proposed Environmental Impact Statement (EIS) on waste management activities for groundwater protection at the plant. The results of groundwater and atmospheric pathway analyses, accident analysis, and other environmental assessments discussed in this document are based upon a conservative analysis of all foreseeable scenarios as defined by the National Environmental Policy Act (40 CFR 1502.22). The scenarios do not necessarily represent actual environmental conditions. This document is not meant to represent or be used as a regulatory closure plan or other regulatory sufficient document. Technical assistance in the environmental analyses of waste site closures was provided by Clemson University; GeoTrans, Inc.; JBF Associates, Inc.; S.S. Papadopulos and Associates Inc.; Radiological Assessments Corporation; Rogers and Associates Engineering Corporation; Science Applications International Corporation; C.B. Shedrow Environmental Consultants, Inc.; Exploration Software; and Verbatim Typing and Editing.

37827 **(PB—87-173175/XAB) Studies of a method of wetland reconstruction following phosphate mining. Final report.** Brown, M.T.; Odum, H.T. (Florida Univ., Gainesville (USA). Center for Wetlands). Sep 1985. 81p. NTIS, PC A05/MF A01.

The successful restoration of wetland ecosystems following surface mining is among the Florida phosphate industry's highest priorities. After nearly a decade of wetland reclamation research, the most-reliable rehabilitation technique to have emerged is spreading organic topsoil from a donor wetland being disturbed onto a recontoured wetland basin being reclaimed. The report quantifies the establishment and survival of wetland plants on a reclaimed wetland area in north Florida that had been treated with salvaged peat. The value of spreading the soil is considered from three perspectives: the influence of thickness, the pattern of application, and the cost of excavating, transporting and spreading. The research concludes that proper hydroperiod is one of the most critical parameters that must be controlled in reclaiming wetlands.

37828 **(UCRL—15873) Vegetation of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California.** Taylor, D.W.; Davilla, W. (BioSystems Analysis, Inc., Santa Cruz, CA (USA)). Nov 1986. Contract W-7405-ENG-48. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011345.

Lawrence Livermore National Laboratory (LLNL) administers and operates an approximately 28 km² (10.9 mi², 7000 acre) test site known as Site 300. This expanse of rolling hills and canyons supports a diverse array of grassland communities typical of lowland central California. The report quantitatively describes the variation of vegetation within Site 300, and relates vegetation to potential environmental impacts associated with present operation and possible expansion of on-site facilities.

37829 **Channel model of flow through fractured media.** Tsang, Y.W.; Tsang, C.F. (Lawrence Berkeley Lab., CA). *Water Resources Research;* **23**: No. 3, 367-479(Mar 1987). Contract AC03-76SF00098.

On the basis of a review of recent theoretical and experimental studies of flow through fractured rocks, the authors have studied the fluid flow and solute transport in a tight fractured medium in terms of flow through channels of variable aperture. The channels are characterized by an aperture density distribution and a spatial correlation length. Aperture profiles along the channels are statistically generated and compared to laboratory measurements of fracture surfaces. Calculated tracer transport between two points in the fractured media is by way of a number of such channels. Tracer breakthrough curves display features that correspond well with recent data by Moreno et al., which lends support to the validity of our model. Calculated pressure profiles along the channels suggest possible measurements that may be useful in identifying the geometrical characteristics of the channels. Finally, predictions were made for tracer breakthrough curves in the case of single fractures under various degrees of normal stress. These suggest possible laboratory experiments which may be performed to validate this conceptual model.

### 5106 Regulations

*REFER ALSO TO CITATION(S) 36547, 36548, 36959, 36960, 37809, 37811, 37812, 37813, 37814, 37857*

## 52 ENVIRONMENTAL SCIENCES, AQUATIC

*REFER ALSO TO CITATION(S) 37859*

### 5201 Basic Studies

*REFER ALSO TO CITATION(S) 36616, 37848, 38037*

37830 (CONF-8608141—, pp 224-233) **Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams.** Hupp, C.R. (Geological Survey). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Woody plants, growing along modified stream channels, provide an accurate tool for estimating dates and rates of bank failure, amounts and rates of bank accretion, and dates of initial bank stability. Channel widening rates as much as 2.4 meters per year occur in response to channelization. Mean bank accretion rates up to 7 centimeters per year occur along modified channels following bed degradation and most channel widening. Establishing vegetation appear to enhance bank stability and are good indicators of stabilizing conditions (pioneer species), particularly black willow, river birch, box elder, and sycamore (Platanus occidentalis). System wide geomorphic and dendroecologic study allows for detailed interpretation of channel evolution following channel modifications. 16 references, 5 figures, 3 tables.

37831 (CONF-8608141—, pp 243-248) **Potential for use of cottonwoods as indicators of past floods.** Clark, S. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Knowledge of the flood history of watersheds is important for several purposes, including reconstructing dates of floods before periods of record or in areas where no records exist, and for studying rates of erosion and deposition. Dendrochronology can be used to establish dates and extents of past floods. Trees may be damaged by flood waters; the resulting injuries will affect growth, showing up as anomalies in the ring-width patterns. in the southwestern US, cottonwoods are often the only large trees found along streams. However, cottonwoods have not been used in any dendrochronological study until now. Reasons for this include difficulty in determining ring boundaries, uncertainty if growth rings are annual, and doubt whether riparian species are limited by water stress. After devising a method using transmitted light to see ring boundaries more clearly, collecting cores from the same trees in two consecutive years to determine that the rings are annual, and establishing that the cores cross-date, the authors attempted to discover what the cottonwoods are responding to. Preliminary results suggest that suppression events occurring in cottonwoods correspond to years of known floods. High water or partial burial of a tree can cause a decrease in growth because less oxygen is available to the roots and there are stresses from the sediment. Cottonwoods can also be used to study rates of sediment deposition. The sampled trees are buried to a depth of 2-4m, indicating that this much material has accumulated since they began growing approximately 130 years ago. 11 references, 3 figures.

37832 (CONF-8608141—, pp 249-260) **Cypress tree-ring analysis in relation to wetlands and hydrology.** Duever, M.J.; McCollom, J.M. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In recent years, bald cypress, Taxodium distichum, has proved to be an extremely useful species in studies involving tree-ring analysis, wetlands, and hydrology. In this paper the authors illustrate the application of tree-ring analysis using bald cypress, to

the resolution of a variety of ecological problems related to wetlands and hydrology. At Corkscrew Swamp Sanctuary, tree-ring analysis provided information on cypress forest structure and dynamics, and how they are related to substrate characteristics, water level fluctuations, site quality, and fire. They were also able to determine the most likely cause of saltwater intrusion into the Loxahatchee River estuary, where a severe dieback of the floodplain forest had occurred, and whether the area impacted had stabilized or was continuing to expand upstream. In another study at Corkscrew Swamp, they were able to assess sanctuary management practices involving water level manipulation. The authors found that year-round inundation adversely affects cypress growth. Cypress recovered quickly when an annual drydown was reestablished following a single year of continuous inundation, but recovery was slower following five years of continuous inundation. 15 references, 7 figures.

37833 **(CONF-8703144—1) Temporal variation in regulation of production in a pelagic food web model.** Bartell, S.M.; Brenkert, A.L.; O'Neill, R.V.; Gardner, R.H. (Oak Ridge National Lab., TN (USA); Science Applications, Inc., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008803.

From Symposium on complex interactions in lake communities; Notre Dame, IN, USA (21 Mar 1987).

We examined the implications of differential resource use and predator-prey relations in a seasonal environment, formalized as a pelagic food web model, on temporal changes in the relative importance of bottom-up and top-down structuring of the phytoplankton. Detailed analyses of the model's behavior were used to identify periods when control of production shifted from interspecific interactions among the phytoplankton to cascading trophic interactions.

37834 **(DOE/BP—847) Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual.** (Idaho Dept. of Fish and Game, Boise (USA). Program Coordination Bureau). Jun 1987. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011911.

The RIVERS program provides easy public access to the information stored in the RIVERS data base, and allows for easy maintenance of the data base by a user friendly menu system. The RIVERS program allows access in printed report form or interactively. Yearly updates are verified and checked for errors before submission to the statewide data base.

37835 **(PB—87-182135/XAB) Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report.** Montgomery, S. (Marine Mammal Commission, Washington, DC (USA)). Apr 1987. 61p. (OCS/MMS—87/0029). NTIS, PC A04/MF A01.

Reliable information on seasonal movements and habitat use patterns is necessary to adequately assess the possible effects of offshore oil and gas development and other human activities on endangered cetaceans. Many cetaceans live in remote, open-ocean, and ice-covered areas that are difficult, expensive, and sometimes dangerous to survey by ship and aerial transits, the methods that historically have been used to determine and monitor distribution and abundance. In such areas, information on movements and other variables possibly can be obtained more cost effectively and with less danger to researchers by using satellite-monitored radio tags attached to representative samples of animals.

37836 **(TR-EL—82-4/82-11-72) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout.** Sutter, F.C.; McIlwain, T.D. (National Wetlands Research Center, Slidell, LA (USA); Gulf Coast Research Lab., Ocean Springs, MS (USA)). Mar 1987. 21p. NTIS, PC A02/MF A01. File Number TI87900645.

Sand seatrout are one of the most abundant fishes in the estuarine and nearshore areas of the Gulf of Mexico. Although silver seatrout are also abundant, little research has been conducted for this species. Sand seatrout spawn in lower estuarine environments or in nearshore gulf waters with two spawning peaks; one in spring, and another in late summer. Silver seatrout follow a similar reproductive pattern. Sand seatrout are common in bays, sounds, and shallow offshore gulf water, while silver seatrout are more abundant in deeper waters. Both seatrout are important components in the industrial bottom fisheries; sand seatrout also are a valuable recreational species. Shrimp and other crustaceans are most commonly eaten by small sand and silver seatrout, while larger fish shift to a more piscivorous diet. Small sand seatrout are usually found in waters with temperatures greater than 15°C and salinity values less than 15 ppt, while larger fish are found over a wider temperature range (5° to 30°C), and in salinities greater than 15 ppt. Silver seatrout generally prefer waters with salinities greater than 25 ppt with temperatures ranging from 5° to 30°C.

## 5202 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 36420, 36968, 37158, 37377, 37584, 37672, 37673, 37767, 37806, 37808, 37810, 37815, 37889, 37997, 38000*

37837 **(AD-A—179076/5/XAB) Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987.** Kristoff, F.T.; Ewing, T.W.; Johnson, D.E. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 31 Jan 1987. 77p. (ADL—54141). NTIS, PC A05/MF A01.

Explosives manufacture and ammunition load, assembly and pack (LAP) operations result in the generation of explosives-contaminated wastewater. Over the years, the Department of the Army has used lagoons for treatment of these wastewaters by evaporation/percolation. These lagoons contain the remaining explosives-contaminated waters and sludges are listed as hazardous wastes under Federal regulations promulgated under the Resource Conservation and Recovery Act (RCRA). The basis for this listing is the assumed explosive reactivity of these wastes if subjected to a strong initiating source or if heated under confinement. The objective of this study was to investigate and define the reactivity of explosive-contaminated soils to flame and shock as a function of explosive composition using the Bureau of Mines (BOM) Zero Gap (shock) and Deflagration to Detonation Transition (DDT flame) tests. The resultant technical data will be used to define the reactivity of explosive-contaminated soil on the basis of compositional analyses. Extensive testing was conducted to investigate and define the reactivity of explosive-contaminated soils to flame and shock stimuli. From these tests, it is also concluded that explosive-contaminated soils can be diluted with virgin soil to reduce the total explosive content of $<$ or $=$ 12% and result in a composition which is not reactive in the BOM flame and shock tests.

37838 **(CONF-8703141—1-Summ.) Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary.** Boston, H.L.; Stewart, A.J.; Johnson, A.R.; Bartell, S.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008804.

From EPA all-investigators meeting; Athens, GA, USA (23 Mar 1987).

This project will evaluate hypotheses concerning the resistance and resilience of aquatic ecosystems exposed to toxic chemicals. Our goals are to develop diagnostic criteria for ecosystem classification and to improve existing methods of ecological risk estimation. The development of models that predict ecosystem level effects requires quantifying the relationships between the underlying control structure of ecosystems (patterns of energy and material flux) and the contributions of thos structures to ecosystem resistance and resilience. We address these problems through an integration of manipulative experiments, multidimensional state space analysis, and ecosystem modeling. These studies will quantify the underlying rate structure in pond and stream systems (including, production, herbivory, nutrient uptake and recycling) and will measure changes in their structures in response to perturbations by toxicants.

37839 **(PB—87-175311/XAB) Water-quality-modeling software available from US EPA (Environmental Protection Agency).** Barnwell, T.O.; Vandergrift, S.B.; Ambrose, R.B. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Mar 1987. 16p. (EPA—600/M-87/007). NTIS, PC A02/MF A01.

Water quality models are used in conducting evaluations of waste loads from point and nonpoint sources and in pollutant-exposure assessments. To encourage the wider application of these techniques, the Office of Research and Development of the U.S. Environmental Protection Agency established the Center for Water Quality Modeling to provide a focal point for water quality modeling activities. The Center supports several modeling techniques and computer programs for water quality analysis ranging from techniques appropriate for preliminary analysis to sophisticated models for detailed planning. The paper describes the models supported by the Center and presents an overview of the Center's activities, which include distribution and maintenance of computer programs, training of users, and sponsorship of a users group.

37840 **(PB—87-176269/XAB) Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum.** Rappaport, B.D.; Scott, J.D.; Martens, D.C.; Reneau, R.B.; Simpson, T.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). 1987. 106p. (VPI-VWRRC-Bull—154). NTIS, PC A06/MF A01.

Research was conducted during 1984 and 1985 to determine Cd, Cu, N, Ni, P, and Zn availabilities to barley (Hordeum vulgare) and corn (Zea mays) grown on four sludge-amended soils. An aerobically digested sewage sludge, which was dewatered for approximately 2 years on sandbeds, was obtained from a sewage-treatment plant with major industrial inputs. A 14-day anaerobic N incubation study indicated that mineralization of sludge organic N varied from 9.2% at the 42 Mg ha(-1) sludge rate to 4.2% at the 210 Mg ha(-1) rate. This relatively low percentage of N mineralized from the sludge may reflect the inhibitory effects of the high sludge-metal levels on N transformations and the changes in sludge composition during long-term dewatering on sandbeds. Sludge application increased crop yields, except where the amounts of N mineralized from the sludge was inadequate to supply the N requirement of the crop. Crop yields were not decreased by either metal phytotoxity or P deficiency on the four sludge-amended soils.

37841 **(PB—87-176277/XAB) Evaluating potential groundwater contamination from contaminated soils.** Pratt, J.R.; McCormick, P.V.; Pontasch, K.W.; Cairns, J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). 1987. 37p. (VPI-VWRRC-Bull—155). NTIS, PC A03/MF A01.

Contamination of soils at toxic and hazardous-waste sites can adversely affect groundwater and surface water. Water-soluble materials can move in soil by leaching and percolation and by runoff. The project evaluated the toxicity of leachable toxicants from seven soils, five of which were obtained from designated toxic or hazardous-waste sites. Acidified, dechlorinated tap water was used to extract toxic materials from surface soils. Extracts were used as complex mixtures in acute-toxicity tests using Daphnia and in chronic-effect tests using microcosms. Three classes of effects were observed. Some leachates (including control soils) showed no toxicity. Some soil leachates had moderate acute toxicity (50-80% diluted leachate) and no chronic toxicity. Very toxic soils showed both acute and chronic toxicity at <3% leachate. Toxicological evaluations of contaminants in waste-site soils can provide information not available from chemical analyses and may be useful in verifying the effectiveness of cleanup effort.

37842 **(PB—87-178273/XAB) Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo.** Tennant, D.A.; Walker, S.L.; Lavelle, J.W.; Baker, E.T. (Pacific Marine Environmental Lab., Seattle, WA (USA)). Feb 1987. 35p. (NOAA/TM-ERL-PMEL—69). NTIS, PC A03/MF A01.

The purpose of the manual is to describe a practical approach to the measurement of the size and settling velocity characteristics of sewage-sludge particles in seawater. Three measurement sequences are required for complete characterization, but each can be performed separately according to the goals or needs of the user. The first measurement sequence provides percent total solids and some size characterization of the material. The second set of measurements results in a settling velocity distribution of the larger (coarser) fraction of the sludge. The third sequence of measurements is intended to provide a settling velocity distribution for the fine fraction of sludge particulates. The user of the manual must first decide how much information about his samples is needed.

37843 **(PB—87-181582/XAB) Effects of acidification on stream ecosystems.** Burton, T.M.; Stanford, R.M.; Allan, J.W. (Michigan State Univ., East Lansing (USA)). 1982. 30p. NTIS, PC A03/MF A01.

Pub. in Acid Precipitation: Effects on Ecological Systems, 209-235(Mar 1982.

The purpose of the paper is to summarize known effects of acid precipitation on stream ecosystems, with emphasis on the Great Lakes region. Unfortunately, very little research has been conducted on streams in much of the Great Lakes region. Thus, data are utilized from other regions of the United States as well as from Norway, Sweden, and elsewhere; from laboratory studies on effects of pH on biota; and from the authors own research on effects of pH on soft-water streams in Michigan to summarized probable effects on stream ecosystems within the region.

37844 **(PB—87-182630/XAB) National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report.** Bonoff, M.B.; Groeger, A.W. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Apr 1987. 30p. NTIS, PC A03/MF A01.

The Western Lake Survey-Phase I was conducted during the fall of 1985 as a synoptic chemical survey to characterize lakes located in regions of the western and northwestern United States thought to be potentially susceptible to the effects of acidic deposition. The Western Lake Survey is part of Phase I of the National Surface Water Survey which is designed to assess the problem of acidic deposition on a national scale. The document describes the planning and execution of the Western Lake Survey-Phase I field sampling and field laboratory operations.

37845 **(PB—87-186292/XAB) Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report.** (National Research Council, Washington, DC (USA). Water Science and Technology Board). 1985. 245p. NTIS, PC A11/MF A01.

A review of the 1978 Great Lakes Water Quality Agreement between the United States and Canada was undertaken beginning in 1984 and ending with the issuance of a final report from a binational committee of the Royal Society of Canada and the National Research Council in December 1985. A major opportunity to review the Agreement comes in 1986 after the International Joint Commission (IJC) issues its third biennial report, and the committee's report can be a valuable resource in such a review. The report covers four major areas concerning the Lakes and the Agreement: enrichment, toxic contaminants, institutional arrangement and the ecosystem approach and sustainable development.

37846 **(TVA/ONRED/AWR—87/25) Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir.** Dycus, D.L.; Hickman, G.D. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Nov 1986. 40p. NTIS, PC A03/MF A01. File Number DE87900852.

A study was initiated in autumn 1985 to examine levels of selected contaminants in composited flesh from channel catfish, largemouth bass, and carp and livers from channel catfish. Fish were collected in, upstream of, and downstream of the area of the reservoir where industrial development is expected to occur. Results showed levels of DDTr were low in all species from all locations. PCB levels were low in largemouth bass and carp but not in channel catfish. Four of the 12 composite channel catfish samples exceeded the Food and Drug Administration tolerance of 2.0 μg/g

(max 3.2 μg/g and only one sample had a level less than 1.0 μg/g. There was no statistically significant difference in PCB levels among the four sample locations, although there was a tendency toward high levels at downstream locations. Further examination of PCB levels in catfish was recommended. Of all the metals on the EPA priority list, only Cr, Ni, and Hg were found in significant amounts. Catfish analyzed for PCB should also be analyzed for metals.

37847 **Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington.** Oberlander, P.L.; Myers, D.A. (Battelle Pacific Northwest Lab., Richland, WA). *Water Resources Bulletin;* **23**: No. 3, 487-492(Jun 1987).

The well field serving the Lyons Ferry Fish Hatchery has experienced reduced water temperatures following continued, periodic withdrawal of large volumes of water. In January 1985, the well field temperature was 49°F, which is less than the optimal 52°F for raising salmon and steelhead trout. The aquifer supplying the hatchery is in hydraulic and thermal connection with the Snake River and a flooded embayment of the Palouse River. Groundwater temperatures in the well field cycle on an annual basis in response to changes in surface water temperature and pumping rate. Numerical simulation of the well field, using a simplified mixing cell model, demonstrates the coupling of well field hydraulics and aquifer thermal response. Alternative pumping schedules indicate that it is feasible to adjust ground-water pumping to effectively store heat in the aquifer during the summer months when surface water temperatures are elevated. Sensitivity analysis of this model indicated that the primary controls of the system's thermal response are the volume of the aquifer assumed to contribute to the well field and temperature of the overlying surface water body.

## 5203 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 36533, 36541, 36550, 37722, 37723*

37848 **(CONF-8704123—2) An improved method for the simultaneous determination of $^{224}$Ra, $^{226}$Ra and $^{228}$Ra in water, soils and sediments.** Lucas, H.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011415.

From Conference on radon, radium, and other radioactivity in ground water: hydrogeologic impact and application to indoor airborne contamination; Somerset, NJ, USA (7 Apr 1987).

The naturally occurring concentrations of radium ($^{226}$Ra and $^{228}$Ra) in public and private water supplies have been studied for many years. Both general surveys ad local studies have established the geographical regions where well waters exceed 3 pCi/L (1-17). In general, the $^{226}$Ra was determined by the emanation method, while the $^{228}$Ra was determined from the beta activity of the $^{228}$Ac daughter. In a recent review (18) of the methods used "a number of approved analytic methods can bear improvement, especially the method for 228Ra." The purpose of the work described here was to develop an improved method for the simultaneous determination of $^{226}$Ra and $^{228}$Ra. 22 refs., 3 tabs.

37849 **(EPS—3-PG-1) Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations.** (Dearborn Environmental Consulting Services (Canada)). Sep 1985. 189p. Dearborn Environmental Consulting Services, Canada.

The objective of this study was to examine the radioactivity in coal, ashes and related wastewater streams at Canadian steam electric generating stations. The kinds of radioactive substances which occur naturally in coal formations, the nature of their emissions, and existing information on their behaviour, and their effects on environmental organisms are also reviewed. Although the releases in wastewaters from the six stations studied were found to be low, there is no information on the long-term effects from such low-level releases. It is recommended that further studies be conducted in this area. 174 references.

37850 **(NUREG/CR—4615-Vol.2) Modeling study of solute transport in the unsaturated zone: Workshop proceedings.** Springer, E.P.; Fuentes, H.R. (eds.). (Los Alamos National Lab., NM (USA); Texas Univ., El Paso (USA). Dept. of Civil Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Apr 1987. Contract W-7405-ENG-36. 248p. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2). NTIS, PC A11/MF A01 - GPO. File Number TI87009181.

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

Issues addressed were the adequacy of the data for the various models, effectiveness of the models to represent the data, particular information provided by the models, the role of caisson experiments in providing fundamental knowledge of porous-media water flow and solute transport, and the importance of geochemistry to the transport of nonconservative tracers. These proceedings include the presentations made by each of the modelers; the summary document written by the panel; and a transcript of the discussions, both the discussions that followed individual presentations and the general discussion held on the second day. This publication completes the series on the workshop. Volume I in the series (NUREG/CR-4615, Vol. I) contains background information and the data sets provided each modeler.

37851 **(PB—87-185088/XAB) Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report.** Oural, C.R.; Brooker, H.R.; Upchurch, S.B. (University of South Florida, Tampa (USA)). Jan 1986. 100p. NTIS, PC A05/MF A01.

The central Florida phosphate industry utilizes recharge wells to mitigate withdrawals of water from the Florida aquifer and to dewater the surficial aquifer prior to mining. From a water-management point of view, these wells are efficient and serve a vital function. Recent monitoring of the radiation environment in these wells, however, casts doubts on the safety of the wells. While most of the wells conform to state and federal standards for radium, gross-alpha radiation frequently exceeds standards. The purpose of the study was to determine the radionuclide(s) responsible for the high gross-alpha radiation and to identify a method for sampling of the recharge wells that would standardize data across the phosphate district. It was found that excess gross alpha is primarily due to polonium-210. Since gross alpha and polonium-210 measurements are quite sensitive to methods of sample collections, preservation and analyses, standard procedures for sample processing are presented in the report.

37852 **(UCID—20754) Concentrations of radionuclides in fish collected from Bikini Atoll between 1977 and 1984.** Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Jokela, T.A.; Brunk, J.A. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 62p. NTIS, PC A04/MF A01. File Number DE87011905.

This report summarizes all available data on the concentrations of radionuclides in fish from Bikini Atoll between 1977 and 1984. As found in other global studies, $^{137}$Cs is most highly accumulated in edible flesh of all species of fish, the lowest fractions are found in the bone or liver. The mean concentration of $^{137}$Cs in muscle of reef fish from the southern part of the atoll is comparable to the global fallout concentration measured in market samples of fish collected from Chicago, Illinois, in 1982. $^{90}$Sr is generally associated with non-edible parts of fish, such as bone or viscera. Twenty-five to fifty percent of the total body burden of $^{60}$Co is accumulated in the muscle tissue; the remainder is distributed among the liver, skin, and viscera. The mean concentration of $^{60}$Co in fish has been decreasing at a rate faster than radiological decay alone. Most striking is the range of $^{207}$Bi concentrations among different species of fish collected at the same time and place. Highest concentrations of $^{207}$Bi were consistently detected in the muscle (and other tissues) of goatfish and some of the pelagic lagoon fish. In other reef fish, such as mullet, surgeonfish, and parrotfish, $^{207}$Bi was usually below detection limits by gamma spectrometry. Over 70% of the whole-body activity of $^{207}$Bi in goatfish is associated with the muscle tissue, whereas less than 5% is found in the muscle of mullet and surgeonfish. Neither $^{239+240}$Pu nor $^{241}$Am is significantly accumulated in the muscle tissue of any species of fish. Ap-

parently, $^{238}Pu$ is in a more readily available form for accumulation by fishes than $^{239+240}Pu$. Based on a daily ingestion rate of 200 q of fish flesh, dose rates to individuals through the fish-food ingestion pathway are well below current Federal guidelines.

37853 **(UCID—21031) Tritium in groundwater at Site 300.** Buddemeier, R.W.; Ruggieri, M.R.; Oberdorfer, J.A. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 190p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011695.

This report presents the results and conclusions to date of the continuing investigation of groundwater tritium contamination in the vicinity of landfills and an experimental facility. A program of monitoring groundwater, soil moisture, and rainfall in the study area has produced new insights into hydrogeology and contaminant migration in the Pit 7 landfill complex. Groundwater recharge in the area is highly episodic and appears localized in an area to the west of the landfills. The additional data obtained support the hypothesis that tritium was released from the landfills as a result of flooding due to rising water table during a period of unusually high precipitation in 1982 and 1983. Groundwater and tritium migration velocities have been determined for the landfill plumes by a variety of methods: direct observation of tritium movement, retrospective analysis of tritium displacement, and calculation of water velocities from field determinations of hydraulic gradient and hydraulic conductivity. The most probable values for the Pit 3 and Pit 5 plumes are in the range of 5 to 20 meters/year, with an upper limit of 60 m/y in the case of the Pit 5 plume. Analytical models have been used to predict and explore the probable behavior of the landfill plumes. By using a conservative velocity value of 30 m/y and other model parameters selected to fit the observed plumes, decay-corrected tritium activities are shown to fall below the drinking water standard before either plume reaches the Site 300 boundary. Tritium above background levels has been found at additional locations within the second water bearing zone in the East Firing Area. This appears to represent an extension of the plume that originates near Building 850: it apparently has been transported to the East Firing Area along Doall Ravine streambed. A program of investigation is in progress to characterize the extent, transport, and probable future behavior of this plume.

### 5204 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 36617*

### 5205 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 36439, 36459, 36519, 36970, 37825*

37854 **(BMI/ONWI—640) Regional ground-water flow near Richton and Cypress Creek Domes, Mississippi: Annual status report for fiscal year 1984.** (Earth Technology Corp., Long Beach, CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 260p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87011006.

The reported work is part of an ongoing evaluation of Richton and Cypress Creek salt domes, located in Perry County, Mississippi, as potential repositories for high-level nuclear waste. This report describes the refinement of previously developed conceptual and numerical models of regional ground-water flow in the vicinity of the domes, based on extensive evaluation of all available hydrologic data and on application of a computer flow code. This report summarizes the hydrologic data used to refine the conceptual model, characterizing model boundary conditions and determining best estimates and bounds of reasonable certainty for hydraulic properties and flow in the major hydrogeologic units. Refined inputs were applied to the numerical model for calibration. GRAM (Version 3.01), a three-dimensional finite-element flow code, was used for numerical modeling. The numerical model, calibrated to measure water levels, calculated fluxes and water budgets by applying parameter estimation by least squares regression. A two-dimensional vertical slice model aided in calibrating the three-dimensional regional ground-water flow model. The report describes the calibration procedure and assesses the resulting model. The results of the data evaluation and the computer code application are described with emphasis on best estimates and bounds of reasonable certainty for ground-water flow parameters in the regional model area and on behavioral aspects of the ground-water flow system. The refined conceptual and numerical models of regional groundwater flow described in this report are not considered final. Potential work to further refine the models is outlined in the final section of the report.

37855 **(CONF-870410—33) Production and characterization of pyrolysis liquids from municipal solid waste.** Helt, J.E.; Agrawal, R.K. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011526.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Bench-scale studies characterizing the liquids produced in the pyrolysis reactions are addressed for experimental results on the thermal decomposition of typical MSW components (Whatman No. 1, newsprint, kraft paper, cardboard, aspen,and pine) over a temperature range of 275 to 475°C.

37856 **(TVA/ONRED/WRF—85/1b) Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984.** Bruggink, D.J.; Buchanan, J.P.; Dycus, D.L.; Murray, S.A.; Ostrowski, P. Jr.; Smith, A.O.; Swor, C.T.; Tomljanovich, D.A.; Wade, D.C.; Webb, D.H. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jun 1985. 291p. NTIS, PC A13/MF A01. File Number DE87900883.

Evaluation of 1984 operational monitoring data, comparison of these data to previous operational and preoperational data, and recommendations for continuation or discontinuation of each type of study are presented in this report. Comparisons of aquatic parameters upstream and downstream of SQN showed numerous differences among stations and/or over time. Most of these differences were considered unimportant or thought to be associated with factors. Therefore, it is recommended that he following be discontinued: benthic macroinvertebrate community studies; mollusk bioaccumulation studies; fish impingement studies; fish gill net studies; and fish creel studies. Plankton studies should continue. Data are included in this volume.

### 5206 Regulations

*REFER ALSO TO CITATION(S) 36959, 36960, 37845, 37857*

## 53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

*REFER ALSO TO CITATION(S) 36750*

37857 **(ENEA-RT/STUDI—86-3) Environmental indicators: a comparison of international trends.** Malatini, S.; Pinchera, G.C. (ENEA, Rome (Italy)). May 1986. 27 p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752641.

In order to preserve, mantain and reclaim environmental quality, and to assess the results of past actions, on an international as well as on a national or local level, a tested environmental accounting system is required. Usually, unlike economics or energy surveys, environment accounting, where performed, does not rely on tested sets of indicators, in single countries, or standardized, and thus comparable, at an international level. Some international agencies (OCSE, UNECE, CEE, and so on), at different degrees of advancement, are devoting great efforts to develop sets of indicators, and similar system. This article reviews achievements and trends to this aim, in some industrialized countries, as well as formulations and selected sets of indicators provided by some international agencies to assess both state and changes over time of environmental quality. Two categories of environmental survey are taken into ac-

count in this work: air quality and land quality. A first check of necessary versus available official data for land quality accounting in Italy is performed.

### 5301 Social And Economic Studies

*REFER ALSO TO CITATION(S) 36961*

37858 (CONF-8608141—, pp 543-553) **Intervention detection - a systematic technique for examining shifts in radial growth rates of forest trees.** Downing, D.J.; McLaughlin, S.B. (Oak Ridge National Lab., TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Recent emphasis on characterizing possible changes in growth patterns of forest trees in response to environmental stress has highlighted the need for systematically evaluating the frequency, magnitude, and duration of past and recent shifts in those growth patterns. Intervention detection, an ARIMA technique for identifying the timing of significant shifts within time series, has been applied to analyze regional trends in radial growth of red spruce during the past 120 years. Intervention detection was coupled with intervention analysis, using a transfer function approach, to identify and evaluate the significance of growth shifts. This technique allows one to evaluate both short-term pulses as well as more persistent step-level changes and to concurrently characterize the frequency and timing of positive and negative shifts in growth trends. Applied to a regional red spruce data set from 69 predominantly high elevation sites with over 200 cores, this approach provided evidence that radial growth rate reductions during the past 15 years appear unique in the past 150 years of tree ring record of surviving trees. Criteria were the magnitude and duration of negative step changes and the low frequency of positive changes within this time period signaling a unique combination of events. Differences in the timing and magnitude of changes between northern and southern stands are noted. These techniques are suggested to have good potential for detecting and contrasting responses within and between other species and stands of forest trees. 17 references, 2 figures.

### 5302 Assessment Of Energy Technologies

*REFER ALSO TO CITATION(S) 36547, 36549, 36550, 36959, 36962, 37562, 37650, 37826, 37853*

## 55 BIOMEDICAL SCIENCES, BASIC STUDIES

37859 (ORNL—6397) **Biomedical and Environmental Sciences Programs: Publications 1986.** Trimble, J.L.; Carter, G.R.; Carter, W.C.; Ellis, J.R.; Norman, V.S. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 71p. NTIS, PC A04. File Number DE87011963.

This document is a bibliography of 563 references to journal articles, books, book chapters and proceedings, reports, and abstracts that were published in 1986 under Oak Ridge National Laboratory (ORNL) Biomedical and Environmental Sciences Programs. Over 240 journal articles were published in 1986. Five books were published in 1986, four written and one edited by ORNL scientists. 563 refs.

### 5502 Biochemistry

*REFER ALSO TO CITATION(S) 36623, 36625, 36626, 36640, 37937*

37860 (CONF-870523—3) **Evaluation of separation and purification processes in the antibiotic industry.** Bienkowski, P.R.; Lee, D.D.; Byers, C.H. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009665.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

The different separation and purification processes for three major types of antibiotics, Penicillins, Cephalosporins and Tetracyclines will be discussed. All antibiotic, processing plants contain two majors sections, a relatively small and highly specialized fermentation section and a very large (60-80% of the plant) separation and purification section. The fermentation sections for the different antibiotics are essentially identical, except for differences in growth media and operating variables, but there are vast differences in the separation and purification sections. Several different separation methods are used including filtration, ultrafiltration, centrifugation, precipitation, extraction, chromatography and various membrane methods. Variables affecting the specific separation and purification configurations include final fermentation broth concentration, byproduct formed during fermentation, the physical properties and molecular structure of the various antibiotics and special purification requirements. Necessary reductions in the separation and purification processes required for rebuilding the antibiotic industry after a national emergency are discussed along with several relatively new separation/purification methods that hold great promise for effecting these reductions, chromatography, supercritical fluid extraction (SCF), and membranes. 35 refs., 10 figs., 2 tabs.

37861 (CONF-8704151—1) **Structure of yeast inorganic pyrophosphastase: A progress report.** Voet, D.; Bunick, G.; Jih, J.H.; Koepke, J.; Ogawa, K.; Secco, A.; Swaminathan, P.; Uberbacher, E. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 4 Apr 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011116.

From UCLA symposium: protein structure and design; Los Angeles, CA, USA (4 Apr 1987).

We have solved the x-ray crystal structure of the yeast enzyme inorganic pyrophosphatase. X-ray data was recorded at -50°C by rotation photography, the intensities determined using OSCAR, and the intensity data scaled by Fourier-Bessel scaling. The phases were determined by the SIR-SAS technique as supplemented by density modification and 2-fold symmetry averaging.

37862 (DOE/ER/13546—1) **Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987.** Haselkorn, R. (Chicago Univ., IL (USA)). Mar 1987. Contract FG02-86ER13546. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010748.

This document describes research conducted between June 1986 and June 1987. Results dealing with the organization and regulation of genes in the photosynthetic bacterium Rhodobacter capsulatus includes cloning, sequencing, and demonstrating characterizing the products of genes that regulate expression of nitrogen fixation genes; the connection between DNA supercoiling mediated by DNA gyrase and nif gene expression; and mapping the entire chromosome of R. capsulatus.

37863 (DOE/EV/05854—9) **[DNA repair and the regulation of replication]: Progress report for 1983-1986.** Taylor, J.H. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1986. Contract AS05-78EV05854. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012153.

Base mismatches are produced either by mistakes in replication or by changes in bases that no longer form proper hydrogen bonds in the duplex. If base mismatches are not repaired before replication a mutation is fixed in one chromatid. Likewise, if repair occurs at random in the two chains, a transition will be produced in one chromatid 50% of the time. On the other hand, if some mechanism directs repair of the new chain near the replication fork, or preferentially removes the mutated base after deamination, no permanent damage is produced. Since methylation occurs at CpG sites on both chains, the mutated base in the 5mC → T transition can in theory be recognized by the methylated base on the complementary chain. Have cells evolved a repair system to recognize and preferentially remove the thymine at these potentially mutable sites? In designing experiments to test the hypothesis that such a system has evolved, we have discovered a more general effect of methylation

on strand discrimination in mammalian cells. We also discovered that nicks in the DNA have as much effect on strand discrimination in mismatch repair as methylated cytosine. Both signals are likely to be recognized by a repair complex that has evolved to repair mismatches produced by mistakes at replication forks (proofreading), where both hemimethylatyed DNA and nicks (between Okazaka pieces) are found. However, the specific configuration produced by deamination of one 5mC at methylated CpG sites in fully methylated DNA may also serve as a signal to restore the site and prevent fixation of the transition. Since some of the 5mCpG sites may have important roles in regulation and differentiation, such strand discrimination may be necessary for maintaining a relatively stable genotype.

37864 **(KFK—4196) Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy.** Then, G.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Jan 1987. 120p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-07019.

The binding of the transition metal hafnium to transferrin was studied under various chemical conditions using time differential perturbed $\gamma\gamma$ angular correlation spectroscopy (TDPAC). Observing the electric quadrupole interaction of the /sup 181/Hf probe nuclei size and symmetry of the electric field gradient induced by the ligands of the metal ions can be determined. The experimental data suggest how homogeneous the binding conditions are and to which extend relaxation phenomena are involved. Due to the excellent time resolution obtained with new BaF/sub 2/ detectors the quadrupole coupling parameters of /sup 181/Hf-transferrin could be determined very accurately. Under nearly physiological conditions different binding configurations were quantitatively characterized by spectroscopic means and distinguished with high specificity.

37865 **Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions.** Cangelosi, G.A.; Hung, L.; Puvanesarajah, V.; Stacey, G.; Ozga, D.A.; Leigh, J.A.; Nester, E.W. (Univ. of Washington, Seattle). *Journal of Bacteriology;* **169**: No. 5, 2086-2091(May 1987). Contract FG06-86ER13532.

The authors isolated approximately 100 analogous EPS-deficient (Exo) mutants of the closely related plant pathogen Agrobacterium tumefaciens, including strains whose EPS deficiencies were specifically complemented by each of five cloned, R. meliloti exo loci. They also cloned A. tumefaciens genes which complemented EPS defects in three of the R. meliloti Exo mutants. In two of these cases, symbiotic defects were also complemented. All of the A. tumefaciens Exo mutants formed normal crown gall tumors on four different plant hosts, except ExoC mutants, which were nontumorigenic and unable to attach to plant cells in vitro. Like their R. meliloti counterparts, A. tumefaciens Exo mutants were deficient in production of succinoglycan, the major acidic EPS species produced by both genera. A. tumefaciens ExoC mutants also produced extremely low levels of another major EPS, cyclic 1,2-$\beta$-D-glucan. This deficiency has been noted previously in a different set of nontumorigenic, attachment-defective A. tumefaciens mutants.

37866 **Characteristics of the formation of enzyme-bound ATP from medium inorganic phosphate by mitochondrial $F_1$ adenosinetriphosphatase in the presence of dimethyl sulfoxide.** Kandpal, R.P.; Stempel, K.E.; Boyer, P.D. (Univ. of California, Los Angeles). *Biochemistry;* **26**: No. 6, 1512-1517(24 Mar 1987). Contract AS03-76ER70102.

Addition of dimethyl sulfoxide promotes the formation of enzyme-bound ATP from medium P/sub i/ by mitochondrial $F_1$ adenosinetriphosphatase that has tightly bound ADP present. Measurements are reported of medium P/sub i/ $\rightleftharpoons H^{18}OH$ exchange and of the dependence of formation of enzyme-bound ATP on P/sub i/ concentration. Attainment of an apparent equilibrium between medium P/sub i/ and bound ATP requires longer than 30 min, even though the rates of P/sub i/ binding and release after apparent equilibrium is reached would suffice for a faster approach to equilibrium. Slow protein conformational changes or other unknown modulating factors may be responsible for the slow rate of bound ATP formation. After apparent equilibrium is reached, each P/sub i/ that binds to the enzyme reversibly forms ATP about 50 times before being released to the medium. The rate of interconversion of bound ATP to bound ADP and P/sub i/ is much slower than that in the absence of dimethyl sulfoxide as measured with sufficient low ATP concentrations so that single-site catalysis is favored. Although the interconversion rate is slowed, the equilibrium constant for bound ATP formation from bound ADP and P/sub i/ is not far from unity. Dimethyl sulfoxide favors the formation of enzyme-bound ATP by promoting the competent binding of P/sub i/ to enzyme with ADP bound at a catalytic site rather than by promoting formation of bound ATP from bound ADP and P/sub i/.

37867 **Promoter and nucleotide sequences of the Zymomonas mobilis pyruvate decarboxylase.** Conway, T.; Osman, Y.A.; Konnan, J.I.; Hoffmann, E.M.; Ingram, L.O. (Univ. of Florida, Gainesville). *Journal of Bacteriology;* **169**: No. 3, 949-954(Mar 1987).

DNA sequence analysis showed that pyruvate decarboxylase (one of the most abundant proteins in Zymomonas mobilis) contains 559 amino acids. The promoter for the gene encoding pyruvate decarboxylase was not recognized by Escherichia coli, although the cloned gene was expressed at relatively high levels under the control of alternative promoters. The promoter region did not contain sequences which could be identified as being homologous to the generalized promoter structure for E. coli. Hydropathy plots for the amino acid sequence indicated that pyruvate decarboxylase contains a large number of hydrophobic domains which may contribute to the thermal stability of this enzyme.

37868 **Liquid crystalline phases in concentrated aqueous solutions of $Na^+$ DNA.** Rill, R.L. (Florida State Univ., Tallahassee). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 2, 342-346(Jan 1986).

Concentrated aqueous saline solutions of short (146-base-pair) DNA fragments suddenly become turbid and iridescent when the DNA concentration is slightly increased or the temperature is decreased. Microscopic examination through crossed polarizing filters shows that turbidity and iridescence is due to formation of a liquid crystalline DNA phase similar to cholesteric liquid crystals formed by other semirigid, but nonelectrolyte, chiral polymers. Several distinct textures of the liquid crystalline phase or phases are observed depending on DNA concentration, temperature, and method of sample preparation. Textures observed include spherulites with Maltese crosses, striated and highly colored ribbons, whorls of periodic interference fringes, and colored flakes. The liquid crystalline DNA phase coexists in metastable equilibrium with the isotropic phase over a relatively narrow temperature/ concentration range - approximately 175-250 mg/ml and 25-62°C (limit of measurements). At higher concentrations and temperatures above ~25°C, the solutions appear fully liquid crystalline. When concentrated solutions are cooled below room temperature, crystals form due to precipitation of supporting electrolyte. A partial phase diagram is reported for the isotropic → liquid crystal → crystal transitions of solutions of DNA in buffered saline (2 M $Na^+$). The general features of this phase diagram and the critical DNA volume fraction for formation of the anisotropic phase are consistent with the observed and theoretically predicted phase behavior of rodlike or semirigid nonelectrolyte polymers.

## 5503 Cytology

37869 (LMF—115, pp 361-366) **Alterations of bronchoalveolar lavage cytology in cynomolgus monkeys after sequential saline lavages.** Haley, P.J.; Muggenburg, B.A.; Bice, D.E. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The effects of repeated saline bronchoalveolar lavage (BAL) were evaluated on pulmonary cell populations of cynomolgus monkeys. Saline lavage of individual lung lobes resulted in a marked rise in circulating blood neutrophils at 4 h followed by a similar

rise in lavage neutrophils at 24 h after the initial lavage. Differential cell counts of both blood and BAL samples returned to initial levels if subsequent lavages were spaced at 48 to 72 h intervals. Lymphocytes were not recruited to saline-lavaged lung lobes and BAL protein leels did not rise significantly. BAL appears to produce a transient and reversible intra-alveolar influx of neutrophils which is preceded by mobilization of bone-marrow stored neutrophils that is not detectable if lavage procedures are carried out at 72 h intervals. These observations indicate that BAL is a valid method for sampling and assessing pulmonary cellular and fluid constituents if the procedures are performed at intervals of at least 48 to 72 h apart. 7 references, 3 figures.

## 5504 Genetics

*REFER ALSO TO CITATION(S) 37862, 38007*

**37870 Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli.** Abdulrashid, N.; Clark, D.P. (Southern Illinois Univ., Carbondale). *Journal of Bacteriology;* **169**: No. 3, 1267-1271(Mar 1987). Contract FC22-83FE60339.

Successive mutations of Escherichia coli yielded a strain that was able to degrade a variety of heterocyclic oxygen- and sulfur-containing ring compounds. In particular, this strain could use both furan-2-carboxylic acid and thiophene-2-carboxylic acid as sole carbon and energy sources. Nitrogen-containing heterocyclic compounds were not degraded. This mutant was isolated by selecting first for oxidation of furan derivatives and then for thiphene degradation. Genetic analysis revealed that mutations in three novel genes, thdA (12 min), thdC (92 min), and thdD (98 min), were required for thiphene degradation. In addition, constitutively at both of the previously characterized fadR and atoC loci was required for efficient thiophene breakdown. The pathway of furan and thiophene degradation remains obscure, but the inability of the mutants to degrade 5-nitro or 5-bromo-substituted furan derivatives suggests that hydroxylation at position 5 may be involved. Thiophene derivatives were toxic when they were present at concentrations of 0.1% or greater; however, addition of trace amounts of phenylalanine plus tyrosine greatly reduced this effect.

**37871 Electron microscopy of single-stranded structures in the DNA of competent Haemophilus influenzae cells.** McCarthy, D.; Kupfer, D.M. (Brookhaven National Lab., Upton, NY). *Journal of Bacteriology;* **169**: No. 2, 565-571(Feb 1987).

Chromosomal DNAs from exponential-phase and competent cells of Haemophilus influenzae were examined by electron microscopy to determine whether the chromosome undergoes structural changes during competence development. Single-stranded gaps and single-stranded tails formed in chromosomal DNA during competence development. The generation of gaps was dependent on the rec-2 function. Since the rec-2 mutant is defective in the translocation of donor DNA, it was inferred that the gaps were involved in the translocation step of transformation. The generation of single-stranded tails was independent of the rec-1 and rec-2 genes. Therefore, these structures were assumed to play no direct role in the interaction of donor and recipient DNAs during transformation. Gaps were preferentially associated with a readily denaturable, possible A + T-rich fraction of the genome. This finding raised the possibility that hot spots for transformation might be associated with A + T-rich DNA.

**37872 Characterization of bromoethanesulfonate-resistant mutants of methanococcus voltae: evidence of a coenzyme M transport system.** Santoro, N.; Konisky, J. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **169**: No. 2, 660-665(Feb 1987). Contract FG02-84ER13241.

Mutants of Methanococcus voltae were isolated that were resistant to the coenzyme M (CoM; 2-mercaptoethanesulfonic acid) analog 2-bromoethanesulfonic acid (BES). The mutants displayed a reduced ability accumulate [$^{35}$S]BES relative to the sensitive parental strain. BES inhibited methane production from $CH_3$-S-CoM in cell extracts prepared from wild-type sensitive or resistant strains. BES uptake required the presence of both $CO_2$ and $H_2$ and was inhibited by N-ethylmaleimide and several reagents that are known to disrupt energy metabolism. The mutants showed normal uptake of isoleucine and were not cross-resistant to either azaserine or 5-methyltrypotophan and, thus, were neither defective in general energy-dependent substrate transport nor envelope permeability. Both HS-CoM and $CH_3$-S-CoM prevented the uptake of BES and protected cells from inhibition by it. The authors propose that M. voltae has an energy-dependent, carrier-mediated uptake system for HS-CoM and $CH_3$-S-CoM which can also mediate uptake of BES.

## 5505 Metabolism

*REFER ALSO TO CITATION(S) 36476, 37872, 37937, 37962, 37965, 37967, 37968, 37970, 37979, 37980, 37981, 38008*

**37873 (BNL—39905) The application of a synchrotron radiation microprobe to trace element analysis.** Gordon, B.M.; Hanson, A.L.; Jones, K.W.; Kwiatek, W.M.; Long, G.J.; Pounds, J.G.; Schidlovsky, G.; Spanne, P.; Rivers, M.L.; Sutton, S.R. (Brookhaven National Lab., Upton, NY (USA); Chicago Univ., IL (USA). Dept. of Geophysical Sciences). 1987. Contract AC02-76CH00016. 3p. (CONF-8705124—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011304.

From TEMA-6: 6th international conference on trace elements in man and animals; Asilomar, CA, USA (31 May 1987).

Synchrotron radiation is light emitted by electrons when accelerated in a circular orbit. Properties of synchrotron radiation important to trace element analysis by x-ray fluorescence analysis include a broad, continuous and tunable energy spectrum for K- and L-shell excitation of all elements; a linearly polarized source reducing the scattered radiation backgrounds; low energy deposition in the target; and an appreciable flux in narrow energy bandwidths for chemical speciation. Experiments to date have generally used "white" continuous spectra with a low energy absorber and no focussing, but future runs will use focussing mirrors which increase intensities by a factor of more than 1000. Monochromators will be used to select the energy and bandwidths appropriate to the experiment. Detection limits for thin biomedical samples using a solid-state detector, a 0.5 mm beam and a 5 min counting interval were in the range of 30 ppB for calcium to 50 ppB for zinc. A prototype wet cell was designed, constructed and tested using cat cardiac myocytes with the result that major trace elements such as iron could be quantitated in single myocytes. The x-ray microprobe was used to localize gallium in fetal rat bone explants after being cultured in BGJ media containing 25 $\mu$M $Ga(NO_3)_3$. The high brightness of x rays from a synchrotron source makes possible the development of computerized tomography on a micrometer scale. A tomogram of a freeze-dried caterpillar head was produced in a 50 min scan. The pixel size was 30 $\mu$m using a 20-$\mu$m beam. 2 refs., 1 fig.

## 5506 Medicine

*REFER ALSO TO CITATION(S) 37903, 37961*

**37874 (BNL—39724) An introduction to the physics and instrumentation of positron emission tomography.** Bennett, G.W. (Brookhaven National Lab., Upton, NY (USA)). Jun 1986. Contract AC02-76CH00016. 22p. (CONF-8606313—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010041.

From NATO advanced study institute on cerebral blood flow and metabolism; L'Aguila, Italy (2 Jun 1986).

Positron-emitting radionuclides permit the use of electronic collimation and thus achieve higher resolution and better sensitivity than can be obtained with gamma-emitting radiotracers. The evolution of PET imaging systems can be traced from the use of opposed collimated scanning detectors, which had all the limitations of traditional single photon imaging devices, to the present systems which surround the subject with a large volume of detector material. The improvements in system resolution now approach the theoretical limitation imposed by positron-range, and angular deviation. The use of coding permits the use of shared electronics for reading our multiple detectors, which promises to decrease the cost of PET

imaging devices, at some penalty of degraded performance. Improvements in computer architectures and capabilities permit faster reconstruction of the multiple planes imaged by multi-slice imaging systems. Software for distortion correction and image processing are still under development, and the ability to map between different devices requires the coordination of efforts between different groups in the same institution. The development and validation of the mathematical models for tracer kinetic analyses will continue to occupy the attention of clinicians and scientists involved in these developments. The desire to make these devices simple and cheap enough to be used in routine patient care is occupying the attention of industry and pioneering users, but this goal has not yet been achieved. 17 refs., 15 figs., 3 tabs.

37875 **(DESY-SR—86-10) NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations.** Dix, W.R.; Engelke, K.; Glueer, C.C.; Jabs, H.; Graeff, W.; Kupper, W.; Stellmaschek, K.H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). Nov 1986. 20p. NTIS, PC E07; Available from NTIS as TIB/B87-04641.

For routine investigations a non-invasive method of coronary angiography without using a catheter is necessary. When introducing the contrast medium into a peripheral vein, due to dilution in the central circulation it is not possible to get sufficiently good images of the anatomical situation with conventional radiologic equipment. These difficulties can be overcome with digital subtraction angiography (DSA) in energy-subtraction-mode at the K-absorption-edge of iodine (33.17 keV). Today only synchrotron radiation offers enough intensity for this method. The system NIKOS was developed for DSA in energy-subtraction-mode. Main parts of the system are a two beam double crystal monochromator, a scanning device, a two line photodiode detector with large dynamic range and a computer system for data acquisition and image processing. With this arrangement in-vivo investigations of 8 dogs were carried out. The resulting images show, that it should be possible to visualize human coronary arteries down to 1 mm diameter when 10-20 ml contrast medium is rapidly injected into the brachial vein. The necessary extensions of NIKOS for these investigations are under construction.

37876 (LMF—115, pp 389-393) **Mechanical and morphological evaluation of age-related changes in the Beagle spine.** Gillett, N.A.; Gerlach, R.; Cassidy, J.; Brown, S. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Age-related changes were evaluated in the spines of Beagle dogs by biomechanical testing, radiology and pathology. Thirty age-matched healthy Beagle dogs were divided into five groups having mean ages of 2, 5, 8, 11, and 14 years. Spinal radiographs of anesthetized dogs were taken prior to euthanasia and on defleshed pines following necropsy. Cervical, thoracic, and lumbar segments were tested in compression to calculate peak stress, peak strain, and elastic modulus. Adjacent spinal segments were examined histologically. Histological evidence of the disc degeneration and changes in the mechanical properties of the intervertebral disc joint preceded radiographical evidence of spondylosis. Changes in the mechanical properties of the disc space were probably a result of the disc degeneration rather than the spondylytic lesions. 3 references, 4 figures.

37877 **(NCRP—87) Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 28 Feb 1987. 88p. National Council on Radiation Protection and Measurements, 7910 Woodmont Ave., Bethesda, MD 20814. File Number TI87900845.

This report describes the conceptual framework and methodology required for proper assessments of the occurrences, magnitudes, and retentions of internal depositions of radionuclides in people. This report is a basic text to acquaint the reader with the various elements of a successful bioassay program and their limitations for health protection purposes. General information on bioassay procedures is given, as is guidance on critical elements of a bioassay program such as when bioassay is needed, who should participate, how frequently sampling should occur, how the results might be interpreted, and the limitations of bioassay data for health protection purposes. Basic principles are stressed along with general guidance for their application. Bioassay procedures, models, and interpretations can differ for each radionuclide. No attempt has been made to incorporate radionuclide-specific recommendations or models in this report. 100 refs., 6 figs., 7 tabs.

37878 **(ORNL/TM—10377) Nuclear medicine progress report for quarter ending December 31, 1986.** Knapp, F.F. Jr.; Ambrose, K.R.; Goodman, M.M.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011952.

The synthesis of the 4,4′-dimethyl analogue of the model 3,3′-dimethyl fatty acid, 15-(p-iodophenyl)-3,3-dimethylpentadecanoic acid (3,3′-DMIPP), is described. The [I-125] labeled 4,4′-DMIPP was evaluated in fasted rats and surprisingly showed higher myocardial uptake and faster blood clearance than the 3,3′-, 6,6′- and 9,9′-DMIPP analogues [heart(heart:blood), % dose/gm, 30 min: 3,3′ = 5.06 (12:1), 4,4′ = 8.03 (16.7:1), 6,6′ = 2.26 (3.1:1), 9,9′= 3.06 (2.77)]. Since all analogues have the same chain length, differences in tissue uptake and clearance apparently result from the position of geminal dimethyl-branching. This report describes the development of a "kit" for the rapid, one-step radioiodination of N-(p-iodophenyl)maleimide. This work involved the coupling of 4-aminophenylmercuric acetate with maleic anhydride to give the acid amide which was then ring annulated with sodium acetate to give the N-(p-acetylmercuricphenyl)maleimide "kit." The crystalline kit is readily radioiodinated with $\{^{*}I\}I_2$ to give the N-(p-iodophenyl)maleimide protein labeling agent. Shipments of research products were made to medical cooperative programs. 2 refs., 5 figs., 1 tab.

37879 **Calmodulin and calmodulin binding proteins in amphibian rod outer segments.** Nagao, S.; Yamazaki, A.; Bitensky, M.W. (Los Alamos National Lab., NM). *Biochemistry;* **26**: No. 6, 1659-1665(24 Mar 1987).

The calmodulin (CaM) content of fully intact frog rod outer segments (ROS) has been measured using radioimmunoassay. The molar ratio between rhodopsin and total CaM in ROS is 800:1. In the absence of $Ca^{2+}$, the ROS membrane fraction contains only 4% of total ROS CaM. In contrast, in the presence of $Ca^{2+}$, 15% of total ROS CaM is found in the membrane fraction. For half-maximal binding of CaM to CaM-depleted ROS membranes, $3 \times 10^{-7}$ M $Ca^{2+}$ is required. This CaM binding is inhibited by trifluoperazine. CaM binding proteins in the ROS membrane fraction are identified by using two different methods: the overlay method and the use of 3,3′-dithiobis(sulfosuccinimidyl propionate) (DTSSP), a bifunctional cross-linking reagent. $Ca^{2+}$-dependent CaM binding proteins with apparent molecular weights of 240,000, 140,000, 53,000, and 47,000 are detected in the ROS membrane fraction by the overlay method. Anomalous, $Ca^{2+}$-independent CaM binding to rhodopsin is also detected with this method, and this CaM binding is inhibited by the presence of $Ca^{2+}$. With the bifunctional cross-linking reagent, DTSSP, three discrete proteins with molecular weights of 240,000, 53,000, and 47,000 are detected in the native ROS membrane fraction. CaM binding to rhodopsin is not detected with this method. These data suggest that both the $Ca^{2+}$-independent binding of CaM to rhodopsin and the $Ca^{2+}$-dependent binding of CaM to the M/sub r/ 140,000 protein represent binding of CaM to a site(s) which is (are) exposed only after denaturation. $Ca^{2+}$-dependent CaM binding in the cytoplasmic fraction is also evaluated with the overlay method. These data suggest that CaM and its binding proteins participate in the regulation of $Ca^{2+}$-sensitive processes primarily on the ROS disk membranes.

37880 **Epidermal growth factor-nonresponsive 3T3 variants do not contain epidermal growth factor receptor-related antigens or mRNA.** Schneider, C.A.; Lim, R.W.; Terwilliger, E.; Herschman, H.R. (Univ. of California, Los Angeles). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 2, 333-336(Jan 1986). Contract AC03-76SF00012.

The authors have previously isolated three independent variants of Swiss 3T3 cells that are unable to generate a mitogenic response to epidermal growth factor (EGF). Each of the variants is unable to bind $^{125}$I-labeled EGF; each lacks a functional EGF receptor. They used an antiserum to murine EGF receptor to look for an EGF-receptor gene product in wild-type 3T3 cells and in the three EGF-nonresponsive variants. No cross-reactive material could be detected in any of the three variants, either in $^{125}$I-labeled cell extracts or in [$^{35}$S]methionine metabolically labeled cells. 3T3 cells contained mRNA molecules homologous to a cDNA probe for the human EGF-receptor coding region. In contrast, no homologous RNA could be detected in any of the three variants. Analysis of genomic Southern blots of the DNA from 3T3 cells and the three EGF-nonresponsive variants indicated sequences from the EGF-receptor gene are present in the DNA of all four cell lines. These EGF-nonresponsive lines, which demonstrate proliferative responses to a variety of mitogens, will be ideal recipients for structure-function studies of the EGF receptor by transfection of the cloned gene.

## 5507 Microbiology

37881 **Self-protection of Pseudomonas syringae pv. tabaci from its toxin, tabtoxinine-β-lactam.** Knight, T.J.; Durbin, R.D.; Langston-Unkefer, P.J. (Los Alamos National Lab., NM). *Journal of Bacteriology;* **169**: No. 5, 1954-1959(May 1987).

An extracellular toxin, tabtoxinine-β-lactam (TβL), is produced by Pseudomonas syringae pv. tabaci. This toxin irreversibly inhibits its target, glutamine synthetase; yet P. syringae pv. tabaci retains significant amounts of glutamine synthetase activity during toxin production in culture. As part of our investigation of the self-protection of P. syringae pv. tabaci, the authors compared the effects of TβL on Tox$^+$ (TβL-producing, insensitive to TβL) and Tox$^-$ (TβL nonproducing, sensitive to TA) strains. The extent of protection afforded to the Tox$^-$ strain when induced to adenylylate glutamine synthetase was tested. It was concluded that an additional protection mechanism was required. A detoxification activity was found in the Tox$^+$ strain which opens the ϵ-lactam ring to TβL to produce the inactive, open-chain form, tabtoxinine. Whole cells of the Tox$^+$ strain incubated for 24 h with [$^{14}$C]TβL (0.276 μmol/3 x $10^{10}$ cells) contained [$^{14}$C]tabtoxinine (0.056 μmol), and the medium contained TβL (0.226 μmol). Extracts of spheroplasts of the Tox$^+$ stain also converted TβL to tabtoxinine, whereas extracts of the Tox$^-$ strain did not alter TβL. The conversion was time dependent and stoichiometric and was destroyed by boiling for 30 min or by the addition of 5mM EDTA. Penicillin, a possible substrate and competitive inhibitor of this lactamase activity, inhibited the conversion of TA to tabtoxinine. Periplasmic fluid did not catalyze the conversion of TβL.

37882 **Antigenic mosaic of Methanogenium spp.: analysis with poly- and monoclonal antibody probes.** Macario, A.J.L.; Dugan, C.B.; de Macario, E.C. (New York State Dept. of Health, Albany). *Journal of Bacteriology;* **169**: No. 2, 666-669(Feb 1987). Contract FG02-84ER13197.

Eight well-characterized Methanogenium strains, including the six described type strains, were analyzed with poly- and monoclonal antibody probes to examine the antigenic mosaic of the genus. The pattern of cross-reactions showed that the mosaic is complex and varies with the strains; thus, these organisms have developed a considerable antigenic diversity, which is expressed in their envelopes. Every strain shared at least one determinant with at least one other strain, demonstrating the antigenic cohesiveness of the group. This finding, together with the fact that most strains displayed a distinctive antigenic fingerprint (notwithstanding the limited number of probes available), emphasizes the potential of antibodies for rapid identification of new isolates and for direct elucidation of Methanogenium strains in microbial mixtures.

## 5509 Pathology

*REFER ALSO TO CITATION(S) 36480, 37865, 38004, 38015*

37883 (CONF-8608141—, pp 130-141) **Western spruce budworm outbreaks in northern New Mexico: tree-ring evidence of occurrence and radial growth impacts from 1700 to 1983.** Swetnam, T.W. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Douglas-fir tree-ring chronologies were analyzed for evidence of past outbreaks of western spruce budworms. Tree-ring chronologies from ponderosa pine, which is not defoliated by budworms, were used to estimate potential growth in the Douglas-fir during current and past outbreaks. At least eight outbreak periods were identified in the Douglas-fir chronologies between 1700 and 1983. The average interval between initial years of reduced growth periods caused by budworm was 33.8 years. The average duration of reduced growth periods was 14.0 years, and the average maximum and periodic growth reductions were 42.5% and 23.5% of potential growth. 17 references, 4 figures, 2 tables.

## 5510 Physiological Systems

37884 (LMF—115, pp 367-370) **Histopathology of secondary immune responses in the primate lung.** Gillett, N.A.; Mason, M.J.; Bice, D.E. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Histopathologic alterations in the lung following multiple local pulmonary immunization were studied to further investigate the hypothesis that clonal proliferation of immune memory cells within the lung is responsible for antigen responsiveness to subsequent pulmonary challenge. Two cynomolgus monkeys were immunized with sheep red blood cells (SRBC) in the right diaphragmatic lung lobe 4 times at 30 day intervals. The number of lymphocytes producing IgM anti-SRBC antibody was determined in the peripheral blood and lung lavage fluid at multiple times after each antigen challenge. On the fourth day after the fourth immunization, the monkeys were injected with $^3$H-thymidine, sacrificed after 1 h, and lung sections were prepared for histology and autoradiography. Following each challenge, there was a trend of increasing SRBC-AFC in the lung lavage fluid with a concomittant decrease in the blood response. Histologically, multiply immunized lobes exhibited numerous intraseptal perivascular cellular cuffs composed of lymphocytes and large mononuclear cells which showed an increased labeling index. These histopathology findings support the hypothesis that a local clonal expansion occurs within the lung in response to antigen challenge. 3 references, 2 figures, 1 table.

37885 (LMF—115, pp 371-376) **Effect of continuous positive and negative pressure breathing on the respiratory pattern of conscious rats.** de Madron, E.; Mauderly, J.L. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Rodents placed in plethysmographic nose-only exposure tubes may breathe against negative pressure that is maintained in the exposure chamber to avoid leakage. Since this could affect their breathing pattern, the authors measured the steady-state respiration parameters of 10 conscious rats placed in a volume-displacement tube plethysmograph with a neck-seal. The rats breathed against continuous positive of negative airway pressures of 2.5, 5, and 7.5 cm $H_2O$ in random order. Tidal volume, peak inspiratory and peak expiratory flows, minute, and alveolar ventilation were not affected by the pressure changes. However, the breathing strategy was modified. With negative pressures expiration was interrupted more vigorously by an increased diaphragmatic activity, but residual diaphragmatic activity persisted longer to prevent tidal volume from falling due to increasing stress on the expiration. 11 references, 5 figures, 1 table.

37886 (LMF—115, pp 377-381) **Effects of body position on pulmonary function of the F344/N rat.** Gerlach, R.F.; Mauderly, J.L. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Both prone and supine body positions are used for evaluating pulmonary function in anesthetized rodents. The authors measured pulmonary function of F344/N rats in both positions to aid in comparing results among laboratories. Fourteen male rats (17 wk old) from the Institute's colony were anesthetized with halothane and measured in both prone and supine positions by plethysmography. Tests included breathing patterns, lung volumes, lung mechanics, gas distribution, CO diffusing capacity and forced exhalation. The main difference was a reduced airflow resistance for rats in the supine position. There was minimal effect on other parameters. Body position appears to have less effect on the lung function of rats than observed in man and the dog. 8 references, 2 figures, 1 table.

37887 (LMF—115, pp 382-388) **Cross-sectional study of the effects of age on pulmonary function and lung morphology of Beagle dogs.** Gerlach, R.F.; Gillett, N.A.; Muggenburg, B.A.; Mauderly, J.L. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The effects of age on dog lungs were studied to aid in distinguishing between aging and treatment effects in long-term toxicology studies. Respiratory function of 5 males and 5 females at 2, 5, 8, 11, and 14 years of age was measured. Measurements included breathing patterns, lung volumes, lung mechanics, gas distribution, gas exchange CO diffusing capacity (DLCO), blood gases, forced exhalation, and collateral resistance. Morphometric evaluations were performed on lungs of 6 dogs per group. Age-related volume changes, including decreased vital capacity, expiratory reserve volume, and increased residual volume correlated with increased volume fraction, expiratory reserve volume, and increased residual volume correlated with increased volume fraction of alveolar ducts and decreased volume fraction of alveoli. Age-related gas exchange impairment, including reduced DLCO and increased alveolar-arterial (A-a $PO_2$) difference, correlated with increased thickness of alveolar septae. There was no difference in collateral resistance even though the number and size of alveolar pores increased with age. Other changes included reduced forced vital capacity and lung compliance, increased total pulmonary resistance, and less uniform gas distribution with age. Expiratory flows were reduced with age, but were not different when normalized for lung volume. Most of these changes are similar to those occurring in man. 12 references, 3 figures, 1 table.

## 5520 Public Health

*REFER ALSO TO CITATION(S) 36275, 36966, 37449, 37451, 37623, 37625, 37626, 37627, 37628, 37629, 37630, 37631, 37632, 37633, 37675, 37676, 37677, 37678, 37680, 37683, 37684, 37685, 37689, 37692, 37694, 37695, 37696, 37697, 37698, 37699, 37700, 37701, 37702, 37703, 37991*

37888 **(PB—87-173209/XAB) Current Intelligence Bulletin reprints - Bulletins 31 through 47.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 325p. (DHEW/PUB/NIOSH—86-122). NTIS, PC A14/MF A01.

See also PB—83-245845.

Current Intelligence Bulletins 31 through 47 were reprinted. Topics included are the adverse effects of smoking and the occupational environment on worker health; poisoning in the workplace by arsine; health hazards from radiofrequency sealers and heaters; evidence of carcinogenicity from formaldehyde; ethylene-oxide; silicosis from silica flour; ethylene-dibromide; vibration syndrome resulting from the operating of hand held vibrating tools; problems resulting from glycol ethers including reproductive problems among female employees and embryotoxicity; 2,3,7,8-tetrachlorodibenzo-p-dioxin poisoning; 1,3-butadiene and health-related effects among workers including reproductive effects and carcinogenesis; cadmium carcinogenesis in the workplace; monohalomethane hazards including teratogenesis and carcinogenesis; health hazards due to the use of dinitrotoluenes including cancer and reproductive defects; electrical equipment fires and potential health hazards due to polychlorinated biphenyls; methylene chloride carcinogenesis; and the potential carcinogenicity of 4,4'-methylenedianiline. A cumulative list of NIOSH Current Intelligence Bulletins numbers 1 through 47 is also included.

37889 **(PB—87-174165/XAB) Fence: where the community and the workplace meet.** Millar, J.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 24 Feb 1986. 21p. NTIS, PC A02/MF A01.

In this presentation, the speaker discusses the apparent separation between the workplace and the community, the separation of the occupational-health problem from the community environmental-health problem and the question of jurisdiction which arises out of such attempts to separate the issue. He stresses the different origins of environmental and occupational-health considerations, reminding his audience that occupational-health concerns began as a surgical speciality, for treating workers injured on the job. In the community, concerns grew over the purity of public water supplies and adequate sanitation. Chronic problems involving both the workplace and the community include air and water pollution. The production of synthetic chemicals is continuously growing, and with this there is constant concern over exposure of workers during manufacture, use, and cleanup. The author recommends that occupational and community environmental professionals coordinate actions, and share information.

37890 **(PB—87-174207/XAB) Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois.** Zey, J.N.; Stephenson, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 33p. (HETA—85-416-1742). NTIS, PC A03/MF A01.

Potential exposures to organic solvents during the application of single-ply roofing and waterproofing systems were evaluated in response to a request from the United Union of Roofers, Waterproofers, and Allied Workers. The evaluation was conducted at three sites in Chicago, Illinois where roofing contractors were using two roofing systems (ARC and Carlisle) and one waterproofing (WR Grace) system. Air concentrations of toluene, xylene, hexane, acetone, and heptane were measured. Acenaphthalene, fluorene, and naphthalene were detected in air samples collected at the ARC roofing site. Potential hazards observed at both roofing sites included falls from roofs and slipping on slick roof surfaces. Another potential source of injuries was the use of torches for installation of the ARC system. The authors conclude that personal exposures were relatively low for the chemicals evaluated. Contractors should make every effort to determine the principal components of the roofing supplies they are using. Employees should receive adequate training to work safely with the materials involved. Exposure to coal tar and pitch fumes should be minimized due to the risk of cancer.

37891 **(PB—87-176004/XAB) Preliminary evaluations of initial TSCA (Toxic Substances Control Act) Section 8(e) substantial risk notices. January 1, 1985 to December 31, 1986.** (Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances). Mar 1987. 471p. (EPA—560/2-87/001). NTIS, PC A20/MF A01.

See also PB—87-129409.

The volume contains, in ascending submission number order, status reports (i.e., preliminary evaluations) prepared by staff of the Office of Toxic Substances in EPA's Office of Pesticides and Toxic substances for initial submissions received by EPA from chemical manufacturers, importers, processors and distributors from January 1, 1985 to December 31, 1986 under Section 8(e), the substantial risk information reporting provision of the Toxic Substances Control Act (TSCA). The status reports contained in this compendium reflect only the initial phase of the Agency's evaluation process for the submitted information. The TSCA Section 8(e) status reports volume has been published by the Agency for two reasons. First, a volume of Section 8(e) status reports with appropriate indices will make the submitted information more accessible. Second, this

volume may, by providing specific examples of submitted information and EPA's preliminary evaluation of that information, help those persons subject to Section 8(e) understand better the types of information that should be submitted to EPA under this mandatory reporting provision of TSCA.

37892 **(PB—87-183125/XAB) Superfund public health evaluation manual.** (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). Oct 1986. 186p. (EPA—540/1-86/060). NTIS, PC A09/MF A01.

The Superfund Public Health Evaluation Manual has been developed for use by a diverse audience, including EPA regional staff, state Superfund program staff, federal and state remedial contractors, and potentially responsible parties. Individuals having different levels of scientific training and experience are likely to use the manual in designing, conducting, and reviewing public health evaluations. Because assumptions and judgments are required in many parts of the analysis, the individuals conducting the evaluation are key elements in the process. The manual is not intended for use by non-technical personnel to perform technical evaluations, nor to allow professionals trained in one discipline to perform the work of another. Rather, it is the responsibility of remedial project managers, using the manual as a guide, to match the scientific support they deem necessary with the appropriate resources at their disposal.

## 5530 Agriculture And Food Technology

*REFER ALSO TO CITATION(S) 36621*

37893 (CONF-8508235—, pp 21-26) **What does a forest politician expect from forest inventory.** Steinlin, H. (Freiburg Univ., Germany, F.R. Inst. fuer Landespflege). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Forestry is seen as a social system which itself is a political system. Forest policy is defined as: 'All human activities dealing with the relations and interactions between forestry as a social subsystem and the human society of the other side'. Working methods of forest policy are: - analysis of the situation and the role of forestry in the general socio-political system - development of strategies which aim at the strengthening of forestry's position in the general socio-political system - political action aiming at the implementation of the adopted strategies (lobbying, bargaining, convincing) leading to an arrangement with partners or to a political/legal decision - continuous review of the effects or arrangements and political/legal decisions in order to adjust or improve the strategies if appropriate (feed-back). For all these activities forest policy needs a wealth of information from inside and outside of forestry. An important part of these informations can be gathered from inventories and monitoring systems. In the stage of planning and design of inventories and monitoring systems, the forest politician has to be involved in order to discuss which the inventory and how this inventory could be designed accordingly to these needs. The paper deals with several aspects of the special views of the forest politicians in contrast to the forest manager and their consequences for the collection and preparation of information through inventories and monitoring systems.

37894 (CONF-8508235—, pp 45-47) **What does the wood customer expect from inventories of endangered forests.** Hummel, F.C. 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The use of inventories of endangered forests for wood customers as timber industry or some mills is briefly discussed. The economical conditions as volume and type of wood, availability, economic transport distance, continuity of supplies and scale and units of assessment are mentioned.

37895 (CONF-8508235—, pp 49-51) **What does the customer expect from inventories of endangered forests.** Bachmann, P. (Kreisforstamt, Schwarzenburg, Switzerland). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

More than anything, the customer is interested in data on enterprises, stands, and individual trees. The Swiss control sampling method, for instance, yields most valuable data. To counteract the apprehension to which the new forest disease has given rise, the circumferential growth increment of trees, at breast height 1979/1985 in a municipal forest in the Berne Lower Alps was compared on 38 sampling plots with the respective increment in diameter for the period 1969/1979. In all and for the individual species, no decrease in growth increment was noted; in many cases the increment in diameter was even larger statistically than in the previous period. The example underlines the importance of an adequate method of inventory especially in our time. Surveys should therefore be improved, where possible, and their results interpreted in close cooperation with the customers.

37896 (CONF-8508235—, pp 55-59) **Review of recent FAO contributions to inventorying and monitoring of tropical forests (1979-1985).** Singh, K.D. (Food and Agriculture Organization of the United Nations, Rome, Italy). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The paper aims to describe FAO activities with particular reference to inventorying and monitoring of tropical forests. These are divided into three broad classes: Regular programmes, field programmes and unprogrammed activities. The regular programmes include maintenance and updating of global forest resources information systems and development and transfer of technology in the fields of forest inventory, remote sensing, electronic data processing and geographic information systems. The field programmes provide technical assistance, on request, to member countries. They focus on institution building, technology transfers, technical and economic development. Unprogrammed Activities include FAO participation in international meetings and seminars, replies to adhoc enquiries, and services to FAO Headquarters visitors. In conclusion, the paper emphasizes need for integrating forest inventories and monitoring with development problems and recommends following a system approach in solving them.

37897 **(IIUG-pre—85-14) Forestry and forest industries in Liberia. An example in ecological destabilization.** Dorm-Adzobu, C. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1985. 25p. NTIS, PC E07; Available from NTIS as TIB/B87-06482.

The forestry sector in Liberia is the third most important sector of the national economy in terms of foreign exchange after iron ore mining and rubber production. Although the commercial exploitation of Liberia's forests only began in the mid-sixties, the forest cover has already been lost to such a degree that the extension of the Sahel drought into Liberia has become a serious threat. The risk of continuing traditional forest policy has been clearly recognized by the Liberian government and since 1973 the government has been trying to put the use of the forests on a sustainable basis. Furthermore, the slash and burn techniques of forest use by local farmers continues unabided and its impact on deforestation remains uncontrolled. As a result the ratio between reforestation and deforestation reached 1:20 in terms of acreage until 1981, but fell to 1:100 thereafter.

37898 **(ISH—35-Ed.2) Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 1.** Schuettler, C.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jan 1984. 260p. (In German). NTIS, PC E17; Available from NTIS as TIB/B87-04721.

Pt. 2 published as report ISH--49.

In a study of the relevant literature the results of tests on 30 radiation treated spices were evaluated. The tests contain chemical, organoleptical, microbiological and toxicological analyses. Most of the spices were treated with gamma radiation from cobalt-60 sources with doses up to 60 kGy.

37899 **(ISH—49) Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 2.** Schuettler, C.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Sep 1984. 267p. (In German). NTIS, PC E17; Available from NTIS as TIB/B87-04683.

Pt. 1 published as report ISH--35.

In the present second part of a study of the relevant literature the results of tests on 14 radiation treated spices and 2 radiation treated spice-mixtures were evaluated. The tests in this part contain mainly toxicological but also chemical and sensorial analyses. Most of the spices were treated with gamma radiation from cobalt-60 sources with doses between 80 Gy and 60 kGy. This part contains a cumulated subject index for part 1 and part 2.

# 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

*REFER ALSO TO CITATION(S) 37859*

## 5601 Radiation Effects

*REFER ALSO TO CITATION(S) 36819, 37185*

37900 **(AD-A—179688/7/XAB) Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae.** Dalton, J.P.; Strand, M.; Mangold, B.L.; Dean, D.A. (Johns Hopkins Univ., Baltimore, MD (USA). School of Medicine). 15 Jun 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Journal of Immunology, Vol. 136, No. 12, 4689-4694(15 Jun 1986).

The humoral immune response of mice patently infected with Schistosoma mansoni and of mice vaccinated with radiation-attenuated cercariae were compared by radioimmunoassays and one-and two-dimensional polyacrylamide gel analyses of radioimmunoprecipitates. The binding observed with antibodies of mice vaccinated twice with radiation-attenuated cercariae over a period of 7 to 11 wk was less than 50% of the binding observed with antibodies of mice patently infected for 20 wk, but three to four times greater than that obtained with antibodies of mice infected for 6 wk, irrespective of whether the test extracts were derived from schistosomula or adult worms. Sera of vaccinated mice precipitated a restricted number of predominantly high m.w. glycoproteins of both schistosomula and adult worms metabolically labeled with sulfur-35 methionine. Each of the glycoproteins of 36 hr in vitro-cultured schistosomula that was precipitated by the sera of vaccinated mice was also precipitated by the sera of infected mice. Although radiation-attenuated larvae do not reach the adult stage, mice vaccinated with these still elicit a strong immune response against egg glycoproteins. These results show that the antibody response in mice vaccinated with radiation-attenuated larvae differs qualitatively and quantitatively from that of infected mice.

37901 **(CONF-8705116—2) Prediction of the mortality dose-response relationship in man.** Morris, M.D.; Jones, T.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009680.

From NATO RSG5 meeting; Portsmouth, UK (11 May 1987).

Based upon an extensive data base including 100 separate animal studies, an estimate of the mortality dose-response relationship due to continuous photon radiation is predicted for 70 kg man. The model used in this prediction exercise includes fixed terms accounting for effects of body weight and dose rate, and random terms accounting for inter- and intra-species variation and experimental error. Point predictions and 95% prediction intervals are given for the $LD_{05}$, $LD_{10}$, $LD_{25}$, $LD_{50}$, $LD_{75}$, $LD_{90}$, and $LD_{95}$, for dose rates ranging from 1 to 50 R/min. 6 refs., 5 tabs.

37902 **(CONF-8705116—3) Notes on the effect of dose uncertainty.** Morris, M.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009678.

From NATO RSG5 meeting; Portsmouth, UK (11 May 1987).

The apparent dose-response relationship between amount of exposure to acute radiation and level of mortality in humans is affected by uncertainties in the dose values. It is apparent that one of the greatest concerns regarding the human data from Hiroshima and Nagasaki is the unexpectedly shallow slope of the dose response curve. This may be partially explained by uncertainty in the dose estimates. Some potential effects of dose uncertainty on the apparent dose-response relationship are demonstrated.

37903 **(GSF-B—1964) Experimental tumour therapy. 1985 report. Report on the cooperation between the Institute of Radiation Biology of the University of Munich and the Institute for Radiation Biology of the Society for Radiation and Environmental Research, Neuherberg.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Aug 1986. 127p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-06911.

The 1985 annual report documents - once again - the collaboration between the members of the University's Radiobiological Institute and the Radiobiological Department of GSF in the field of experimental radiotherapy. As in the previous years, key areas were concerned with the examination of clinically relevant radiation-induced injuries in normal tissue, the clarification of their pathogenesis and their fractionation behaviour but also possible methods of their prevention. New areas of interest included the experiments performed on rat stomach which allowed to establish a promising animal model for the radiobiological examination of this organ. Experimental tumours were continued to be studied for factors important for tumour resistance in fractionated irradiation; in this context, the high repopulation capacity of a differentiated squamous-cell carcinoma under quasi-clinical fractionation revealed to be particularly remarkable. A further key area was concerned with investigations into the combined action of cytostatics and irradiation or else hyperthermia which were mostly performed in vitro on cell cultures but also on experimental tumours and some normal tissues.

37904 **(GSI—87-2-Prepr.) Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions.** Kraft, G.; Kraft-Weyrather, W.; Blakely, E.A.; Roots, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). Jan 1987. 10p. NTIS, PC E07; Available from NTIS as TIB/B87-04774.

A broad spectrum of particles and energies has been used in the last years to study the influence of the radiation quality i.e. of the physical parameters of the particle beam on the biological effectiveness. In these measurements a common structure of the functional dependence of the induction probability per particle (cross section) from the linear energy transfer is observed for different biological endpoints. Because of the relevance for space research, we present in this report our data from experiments with iron and nickel particles, in particular. Our experiments were designed to investigate the relationship between the inactivation and chromosome aberration in mammalian cells and the induction of single and double strand breaks in SV40 DNA in respect to the parameters of the track formation like LET and particle energy.

37905 **(ISH—92) Carbon and carbon metabolism in the environment.** Holtum, J.A.M.; Latzko, E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1986. 144p. NTIS, PC E11; Available from NTIS as TIB/B87-04775.

The present report contains the following chapters: CO/sub 2/ and photosynthesis, carbon in the soil, carbon isotopes in the en-

vironment, and the global carbon cycle. A lot of figures and tables are presented.

37906 (LMF—115, pp 105-108) **Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$.** Guilmette, R.A.; Muggenburg, B.A.; Diel, J.H. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

In order to study the effect of age at exposure on the biokinetics of inhaled Pu, 16 immature Beagle dogs (3 months of age) received a single brief exposure to a monodisperse aerosol of $^{239}PuO_2$ (1.5 μm AMAD) at a level of 0.02 μCi/kg (0.74 kBq) body weight and are being serially sacrificed through 2 years after exposure. With radiochemical analysis completed on 10 of the 16 animals, retention functions were fitted to the lung, tracheobronchial lymph node, liver, and skeleton data. Thus far, there are no statistically significant differences in the retention of Pu in the lung and tracheobronchial lymph nodes of the immature dogs when compared to dogs that inhaled the same sized aerosol as young adults (18 months of age). There was, however, a five-fold increased amount of Pu that was initially deposited in the skeleton of the immature dog, an increase that is believed to be age-associated. Differences from the young adult dogs were also seen in the uptake and retention of Pu in liver. 2 references, 4 figures, 1 table.

37907 (LMF—115, pp 109-113) **Interactions of plutonium and americium with bone mineral.** Guilmette, R.A.; Hanlon, L.L.; Eidson, A.F.; Rothenberg, S.J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Soluble actinides such as Pu and Am tend to deposit on bone surfaces and remain avidly attached to those surfaces in the absence of bone remodeling. To quantify the degree of binding of Pu and Am to bone mineral, known masses of the actinide citrate complexes were added to stirred suspensions of bone ash for 24 h. The amount of Pu or Am bound to the bone mineral was then determined by centrifugal ultrafiltration. The percent of Pu remaining unbound to the mineral varied between 0.03 to 0.3% for Pu masses in the range of 1 ng to 10 μg. The amount of Am remaining unbound was slightly higher, 0.04 to 1%. To determine whether calcium diethylenetriamine pentracetate (DTPA) could remove Pu or Am once it had attached to bone mineral, physiologically realistic concentrations of DTPA were added to bone ash suspensions with which Pu or Am had been allowed to react for 24 h. The suspensions were ultrafiltered after an additional 24 h. The addition of DTPA to the Pu-containing system resulted in little or no additional Pu in the filtrate, indicating the DTPA was not effective in removing Pu fixed on bone mineral. DTPA did, however, increase the amount of Am in solution in both a time- and concentration-dependent manner.

37908 (LMF—115, pp 151-157) **Toxicity studies of inhaled beta-emitting radionuclides - status report.** Hahn, F.F.; McClellan, R.O.; Boecker, B.B.; Gillett, N.A.; Hobbs, C.H.; Jones, R.K.; Lundgren, D.L.; Mauderly, J.L.; Muggenburg, B.A.; Pickrell, J.A.; Scott, B.R.; Snipes, M.B. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The influence of total dose and dose-rate pattern on the effects of inhaled beta-emitting radionuclides is being studies in laboratory animals. The inhaled radionuclides were either in a relatively soluble form ($^{90}SrCl_2$, $^{144}CeCl_3$, $^{91}YCl_3$, or $^{137}CsCl$), or in a relatively insoluble form ($^{90}Y$, $^{91}Y$, $^{144}Ce$, or $^{90}Sr$ in fused aluminosilicate particles). The organs affected depend on the solubility and chemical characteristics of the radionuclides. Studies with young adult dogs are complemented by comparable studies in other species (mice, rats, and Syrian hamsters), with animals of different ages and animals repeatedly exposed to $^{144}Ce$. 12 references, 2 figures, 2 tables.

37909 (LMF—115, pp 158-166) **Annual report references to dog longevity studies in which all dogs have died.** Boecker, B.B. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Several of the life-span studies involving dogs that inhaled beta-emitting radionuclides have reached the point where all of the dogs have died. References to all annual report summaries for these studies are tabulated for the use of those who need further information on the significant occurrences in each of these studies and when they occurred. 5 figures, 5 tables.

37910 (LMF—115, pp 167-176) **Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects.** Gillett, N.A.; Muggenburg, B.A.; Boecker, B.B.; Griffith, W.C.; Hahn, F.F.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Young adult Beagle dogs were exposed once to aerosols containing $^{90}SrCl_2$ to obtain initial body burdens ranging from 2.5 to 250 μCi $^{90}Sr$/kg body weight (92 to 9250 kBq) and subsequently observed throughout their life span. All of the dogs are now dead. Radiation-induced lesions were confined to the bone, bone marrow, and adjacent soft tissue. Forty-five primary bone tumors occurred in 31 of 66 exposed dogs. Metastasis occurred from 21 tumors with the lung being the most frequent site of metastasis (76%). Twenty-seven were classified as different subtypes of osteosarcoma, 14 as hemangiosarcomas, 3 as fibrosarcomas, and 1 as a myxosarcoma. Four carcinomas arising from soft tissues adjacent to bone were also considered to be $^{90}Sr$-induced. In contrast to bone tumors arising in Beagle dogs chronically exposed to $^{90}Sr$ through ingestion, histologic lesions of radiation osteodystrophy were minimal in this study, indicating that these lesions are not a necessary precursor of osteosarcoma development. The incidences of hemangiosarcomas (31%) and telangiectatic osteosarcomas (11%), in addition to osteosarcomas, suggest that the cell of origin for all of these neoplasms may be a multipotent mesenchymal cell with the potential for various morphologic expressions dependent upon local environmental factors. 7 references, 1 figure, 2 tables.

37911 (LMF—115, pp 177-181) **Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII.** Hahn, F.F.; Hobbs, C.H.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The metabolism, dosimetry, and biological effects of $^{90}Y$ inhaled in fused aluminosilicate particles are being studied in Beagle dogs. Eighty-nine dogs with initial lung burdens ranging from 80 to 5200 μCi (3.0 to 190 MBq) $^{90}Y$/kg body weight and 12 control dogs are being maintained for life-span observations. The lung burdens achieved and the effective half-life of the $^{90}Y$ in this chemical form resulted in a relatively high, rapidly decreasing radiation dose rate to the lung. To date, 88 exposed dogs have died-40 from radiation pneumonitis, 10 from pulmonary neoplasms, and 38 from other causes. All 12 control dogs have died. Only one exposed dog still survives at 5661 days after inhalation exposure. 3 references, 2 figures, 2 tables.

37912 (LMF—115, pp 182-186) **Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII.** Hahn, F.F.; Muggenburg, B.A.; Hobbs, C.H.; McClellan. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs were exposed by inhalation to aerosols of $^{91}Y$ in fused aluminosilicate particles, resulting in initial lung burdens ranging from 11 to 360 μCi (0.4-13 MBq) $^{91}Y$/kg body weight. These 96 dogs plus 12 controls were maintained for life-span observation of toxic and carcinogenic effects. Dogs with the highest lung burdens died at early times with radiation pneumonitis. At later times, tumors were seen in lung, nasal cavity, heart, and tracheobronchial lymph nodes; these organs received the highest radiation doses. Observations are continuing on the 2 exposed dogs that remain alive 5624 and 5721 days after exposure. 2 figures, 1 table.

37913 (LMF—115, pp 187-192) **Toxicity of $^{144}$Ce inhaled in a relatively insoluble form by Beagle dogs XIX.** Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A.; Gillett, N.A.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs are being studied over their entire life span after a single inhalation exposure to $^{144}$Ce in a relatively insoluble form. One hundred and eleven young adult Beagles were exposed once, briefly, to an aerosol of $^{144}$Ce in fused aluminosilicate particles, to achieve initial lung burdens ranging from 0.0024 to 210 μCi $^{144}$Ce/kg body weight (0.089-7800 kBq/kq), and 15 others were exposed to nonradioactive fused aluminosilicate particles. At the present time (at least 15 yr after exposure), 109 dogs that inhaled $^{144}$Ce and 15 control dogs have died or been euthanized. Observations are continuing on the remaining two $^{144}$Ce-exposed dogs. 5 references, 3 figures, 1 table.

37914 (LMF—115, pp 193-197) **Toxicity of $^{144}$Ce inhaled in a relatively insoluble from by immature Beagle dogs. XV.** Boecker, B.B.; Muggenburg, B.A.; Hahn, F.F.; Mauderly, J.L.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Immature Beagle dogs (3 mo old) received a single brief inhalation exposure to $^{144}$Ce in fused aluminosilicate particles to study the long-term biological effects of an inhaled beta emitter in a relatively insoluble form. Forty-nine dogs inhaled graded levels of $^{144}$Ce that resulted in initial lung burdens of $^{144}$Ce ranging from 0.004 to 140 μCi/kg (0.15 to 5200 kBq/kg) body weight. Five control dogs were exposed via inhalation to nonradioactive fused aluminosilicate particles. Thirty-three of the $^{144}$Ce-exposed dogs have died; eleven with lung tumors, four with tumors of the tracheobronchial lymph nodes and seven with non-neoplastic diseases of the respiratory tract. Sixteen $^{144}$Ce-exposed and two control dogs are still surviving. 2 figures, 1 table.

37915 (LMF—115, pp 198-203) **Toxicity of $^{90}$Sr inhaled in a relatively insoluble form by Beagle dogs. XV.** Snipes, M.B.; Hahn, F.F.; Muggenburg, B.A.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

This study was initiated to determine health effects resulting from inhalation of $^{90}$Sr in a relatively insoluble form. Beagle dogs were briefly exposed by inhalation to produce lung burdens of $^{90}$Sr that ranged from 0.12 to 96 μCi (4.4 to 3550 kBq)/kg body weight. High-level exposures caused radiation pneumonitis and pulmonary fibrosis resulting in deaths typically less than 500 days after exposure. Lower-level exposures are producing long-term health effects, including cancer of the lung, heart, and tracheobronchial lymph nodes. Most tumors have been hemangiosarcomas. During the last two years hemangiosarcomas of the tracheobronchial lymph nodes have been very prevalent. Three control dogs and five $^{90}$Sr-exposed dogs died or were euthanized during the past year. The remaining seven exposed and two control dogs are 12 years old and are being maintained for lifetime observation. 2 figures, 2 tables.

37916 (LMF—115, pp 204-207) **Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}$Ce. XII.** Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs were exposed in different inhalation exposure regimens to a relatively insoluble form of $^{144}$Ce to study the biological effects of repeated inhalation exposures as compared with those from a single inhalation exposure. Four groups of 9 dogs each were exposed once every 8 wk for 2 yr (13 exposures). The exposures were conducted to (1) increase the lung burden by 2.5 μCi (93 kBq) 144Ce/kg body weight with each exposure, (2) re-establish lung burdens of 9.0 or 4.5 μCi (330 or 170 kBq) $^{144}$Ce/kg body weight, and (3) expose controls to the insoluble matrix containing nonradioactive Ce. Pulmonary carcinomas (10 dogs) and hemangiosarcomas in the tracheobrochial lymph nodes (5 dogs) were the most prevalent findings in the $^{144}$Ce-exposed dogs. All $^{144}$Ce-exposed dogs are now dead. Two control dogs died during the past year and observations are continuing on the two controls remaining alive at 12.8 yr after the first exposure. 2 tables.

37917 (LMF—115, pp 208-214) **Toxicity of inhaled alpha-emitting radionuclides - status report.** Muggenburg, B.A.; Mewhinney, J.A.; Guilmette, R.A.; Lundgren, D.L.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The toxicity of inhaled alpha-emitting radionuclides is being investigated in a series of interrelated dose-response studies. Dogs, rodents, and nonhuman primates have been exposed to monodisperse or polydisperse aerosols of the oxides of $^{239}$Pu, $^{238}$Pu, $^{241}$Am, or $^{244}$Cm to measure the relative importance of average organ dose, local dose around particles, specific activity, chemical form, particle size, and number of particles inhaled to the development of biological effects. The influence of animal species, age at exposure, and pre-existing lung disease are also being studied because they may influence the toxicity of these radionuclides. 5 references, 3 figures, 2 tables.

37918 (LMF—115, pp 215-225) **Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 μ AMAD particles. B. Monodisperse 3.0 μm particles. XIII.** Mewhinney, J.A.; Hahan, F.F.; Muggenburg, B.A.; Gillett, N.A.; Diel, J.H.; Mauderly, J.L.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs inhaled one of two sizes of monodisperse aerosols of $^{238}PuO_2$ that resulted in graded levels of $^{238}$Pu in the lung. All dogs are being studied for their life span. One-hundred and twenty-five dogs that had initial lung burdens ranging from 0.01 to 1.5 μCi $^{238}$Pu per kilogram body weight (0.37 to 56 kBq/kg) have died, eight with radiation pneumonitis and pulmonary fibrosis, 7 with lung tumors, 84 with bone tumors, 2 with liver tumors, and 24 of miscellaneous causes. Seven control dogs have died. Observations are being continued on 20 exposed and 17 control dogs alive at 3847-4675 days after exposure. 2 references, 7 figures, 1 table.

37919 (LMF—115, pp 226-232) **Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX.** Muggenburg, B.A.; Guilmette, R.A.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs were exposed monodisperse aerosols of $^{239}PuO_2$ of 0.75, 1.5, or 3.0 μm activity median aerodynamic diameter (AMAD) to obtain information on the relative importance of homogeneity of alpha irradiation doses to the lung. The dogs' initial lung burdens ranged from 0.0002 to 2.6 μCi (0.0074 to 96 kBq) $^{239}$Pu/kg of body weight. Thirty-six dogs exposed to the aerosol diluent are the controls. Twenty-eight of 48 exposed dogs have died to date in the study with 0.75 μm AMAD particles, 57 of 96 have died in the study with 1.5 μm AMAD particles, and 50 of 72 have died in the study with the 3.0 μm AMAD particles. Three control dogs of 36 have died. The dogs exposed to $^{239}$Pu that have died to date have died with radiation pneumonitis and fibrous and/or lung cancer. Surviving dogs have lived up to 3500 days after exposure. 6 figures, 1 table.

37920 (LMF—115, pp 233-238) **Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII.** Guilmette, R.A.; Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Immature Beagle dogs have been exposed by inhalation to a monodisperse aerosol of $^{239}PuO_2$ (1.5 μm AMAD) to compare the biological effects with those observed in dogs exposed to a similar aerosol as young or aged adults. The study includes 96 dogs exposed to $^{239}PuO_2$ and 12 controls. The lung burdens of the plutonium-exposed dogs ranged from 0.00030 to 0.80 μCi/kg body weight (0.011-30 kBq/kg). A total of 82 experimental and 11 control dogs are still alive. Seven dogs died this year. Of these, six died of radiation-induced lung disease; the other of a nonradiation cause. As is the case for dogs exposed as young adult animals, the primary causes of death have been lung carcinomas and radiation pneumonitis and fibrosis. However, it is premature to compare the dose-response relationships for the two age groups. 4 figures.

37921 (LMF—115, pp 239-242) **Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII.** Muggenburg, B.A.; Hahn, F.F.; Gillett, N.A.; Guilmette, R.A.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The effects of age at exposure on the metabolism, dosimetry, and biological effects of inhaled particles of $^{239}PuO_2$ are being studied in aged Beagle dogs (8.0 to 10.5 yr of age at exposure). Forty-eight dogs inhaled $^{238}PuO_2$ particles with an activity median aerodynamic diameter of 1.5 μm to achieve initial lung burdens ranging from 0.02 to 0.66 μCi $^{239}Pu$/kg body weight (0.75 to 24 kBq/kg). Twelve other dos were exposed to the aerosol diluent only. Forty-four exposed dogs have died, including one in the past year, and nine control dogs have died, including on in the past year, through 1566 to 2727 days after exposure. Radiation pneumonitis and fibrosis have been the primary causes of death in these aged dogs exposed to $^{239}PuO_2$. Four $^{239}PuO_2$ exposed dogs and three control dogs are still surviving.

37922 (LMF—115, pp 243-246) **Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X.** Diel, J.H.; Hahn, F.F.; Muggenburg, B.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs were exposed once or repeatedly by inhalation to aerosols of $^{239}PuO_2$ to study the relative doses and effects of these two types of exposures. Dogs exposed at high levels died predominantly of radiation pneumonitis and pulmonary fibrosis. Dogs exposed at lower levels, either once or repeatedly, are dying of a variety of causes including lung cancer. Sixty dogs have survived up to 9 years after their first exposure with a total of 18 actual or sham exposures. 2 references, 2 figures, 1 table.

37923 (LMF—115, pp 247-250) **Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals.** Hahn, F.F.; Muggenburg, B.A.; Boecker, B.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Nonstochastic or nontumor effects of irradiation are generally considered to be the results of high radiation doses that occur at early times after exposure. Two situations from long-term studies of dogs that inhaled beta-emitting radionuclides are illustrated to show that nonstochastic effects can occur at long times after exposure and at relatively low doses, those where radiation-induced tumors are expected. Dogs that inhaled $^{144}CeCl_3$ and received radiation doses to the liver developed hepatocellular necrosis and degeneration that was severe enough to cause death in some dogs. Dogs that inhaled $^{144}Ce$ FAP developed a greater number of tumors in nonirradiated tissue than did the controls perhaps through an effect on the immune system. Neither of these possibilities is considered in current approaches to risk estimation for internally deposited radionuclides. 3 references, 3 figures.

37924 (LMF—115, pp 251-256) **Cardiopulmonary function of dogs with plutonium-induced chronic lung injury.** Muggenburg, B.A.; Wolff, R.K.; Mauderly, J.L.; Plaggmier, M.M.; Gerlach, R.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Twenty dogs exposed by inhalation in the study, Toxicity of Inhaled $^{239}PuO_2$ in Beagle Dogs, were evaluated for cardiopulmonary function. Another group of 10 dogs matched by age and sex, but not exposed to $^{239}Pu$, was also given the same cardiopulmonary function tests. The plutonium-exposed dogs were 7 or more years after exposure and ten of the dogs had clinical signs and pulmonary function values indicating radiation pneumonitis-pulmonary fibrosis. The occurrence of radiation pneumonitis-pulmonary fibrosis, a nonstochastic effect, over the same time period and range of lung doses as lung cancer, a stochastic effect, complicates the estimation of lung cancer risk for inhaled plutonium. 4 references, 4 figures, 2 tables.

37925 (LMF—115, pp 257-262) **Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. II.** Lundgren, D.L.; Hahn, F.F.; Griffith, W.C.; Cuddihy, R.G.; Boecker, B.B. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

A study was initiated to determine the risk of lung cancer in rats exposed to relatively low doses from an inhaled beta-emitting radionuclide, $^{144}Ce$. These data will be used in a matrix of dose-response data from several species to estimate the risk of lung cancer in people exposed by inhalation to beta-emitting radionuclides. Of the 2860 rats entered into this study, 465 died during the past year. There were no consistent relationships between the initial lung burdens (ILB) of $^{144}Ce$ and subsequent survival of the rats. Preliminary data indicate that 83% of the ILB was cleared with a half-time of 20 days and 17% cleared with a half-time of 125 days. 7 references, 1 figure, 2 tables.

37926 (LMF—115, pp 263-266) **Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV.** Lundgren, D.L.; Hahn, F.F.; Guilmette, R.A.; Gillett, N.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The toxicity of $^{244}Cm$ is being studied in rats that inhaled monodisperse aerosols of $^{244}Cm_2O_3$ at levels ranging from 1 to 17,000 nCi/kg body weight. Analysis of the retention and dosimetry of $^{244}Cm$ in lung, liver, and skeleton has been completed. Total alpha doses to the lung ranged from 21 +/- 6 rad (0.21 +/- 0.06 Gy) in the lowest group to 6200 +/- 1600 rad (62 +/- 16 Gy) in the highest dose group. Comparable doses to skeleton were 1.5 +/- 0.5 rad (0.015 +/- 0.005 Gy) to 150 +/- 63 rad (1.5 +/- 0.63 Gy) and to liver were 0.03 +/- 0.04 rad (0.0003 +/- 0.0004 Gy) to 7.1 +/- 2.8 rad (0.071 +/- 0.028 Gy). 5 references, 4 tables.

37927 (LMF—115, pp 267-269) **Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II.** Guilmette, R.A.; Gillett, N.A.; Brooks, A.L.; Hahn, F.F.; Eidson, A.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

To investigate the influence of heterogeneity of alpha-radiation dose on the induction of liver cancer, Chinese hamsters were injected intravenously with colloidal thorium dioxide particles (Thorotrast) and are being maintained for life span observations. The biological effects seen as a result of a Thorotrast injections are being compared with results obtained in other hamsters that were injected intravenously with $^{239}Pu$-citrate. As of 9-30-86, 80% of the animals receiving the highest dose of Thorotrast, 200 pCi (7.4 Bq) per gram body mass), 25% of the group receiving 40 pCi Thorotrast (1.5 Bq) per gram, and 22% of the group receiving 8 pCi Thorotrast (0.3 Bq) per gram had died. This compared with a 24% mortality for the animals injected with 200 pCi $^{239}Pu$-citrate (7.4 Bq) per gram and 16 to 18% in control animals. It is premature to draw any inferences relative to the effect of α-radiation dose pattern on the induction of liver cancer in these animals. 1 table.

37928 (LMF—115, pp 306-312) **Interaction of radiation and carcinogens in the production of mutations.** Brooks, A.L.; Seiler, F.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Studies were conducted to determine if synergistic interactions occur between radiation exposure and carcinogenic chemical treatment when given in combination. The frequency of radiation and chemically induced mutations and cell killing was determined CHO cells. The cells were exposed to 500 rad of X-rays or a single concentration of N-methyl-N'-nitro-N-nitrosoguanidine, benzo(a)pyrene, 3-methylcholanthrene, dibenzo(c,g)carbazole, alone, or in combination. For each combination of X rays and a chemical, the observed mutagenic response was less than predicted by an additive model. The mutation frequency was also measured for graded doses of 3-methylcholanthrene and X-ray exposures given alone and in combination. The data were fitted to a surface described as mutation frequency = $4.9 \times 10^{-5} D^2 + 142 C^2 - 2.1 \times 10^{-4} D^2C^2$ where D is dose in rads and C is concentration of chemical in ug/ml. The negative interactive term indicates that over the dose range studied there was an antagonistic interaction between radiation and chemicals in production of mutations. 3 references, 3 figures.

37929 (LMF—115, pp 346-349) **Effect of irradiation on unscheduled DNA synthesis induced by 4-nitroquinoline in tracheal epithelium of rats.** Hahn, F.F.; Kennedy, R.; Brooks, A.L. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Unscheduled DNA synthesis (UDS) was determined in rat epithelium by autoradiographic techniques to determine the influence of prior irradiation on the ability of the cells to repair mutagenic damage induced by 4-nitroquionoline (4NQO). UDS was stimulated by in vitro exposure to 4NPO. However, prior whole-body irradiation of rats with either 50 or 300 rad did not alter the UDS induced by 4NQO. The results of this study do not support the hypothesis that irradiation can induce DNA repair enzymes in respiratory tract epithelium. 5 references, 3 figures.

37930 (LMF—115, pp 394-396) **Preventing the translocation of inhaled $^{241}Am$ in dogs using continuously infused DTPA.** Guilmette, R.A.; Muggenburg, B.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The objective of this study was to reduce the translocation of $^{241}Am$ from lung to liver and bone in dogs that inhaled a moderately soluble aerosol of $^{241}AmO_2$. To accomplish this, two dogs that inhaled a polydisperse aerosol of $^{241}Amo_2$ received a subcutaneous implantation of a set of osmotic pumps containing the chelating agent diethylenetriaminepentacetic acid (DTPA). These pumps ensured that DTPA was present in the circulation at all times during the 64-day duration of the experiment. To compare the efficacy of this treatment, another pair of dogs that inhaled $^{241}AmO_2$ received DTPA by discrete intravenous injections. A third pair of exposed dogs served as a control group and received saline injections. Although results to date are preliminary, it appears that the use of continuously infused DTPA was significantly more effective than the injected DTPA treatment in reducing the translocation of solubilized Am from lung to the liver and skeleton. Future results will provide better quantification of the effectiveness of the continuous-infusion therapy approach. 1 reference, 1 table.

37931 (NUREG/CR—4653) **GASPAR II: Technical reference and user guide.** Strenge, D.L.; Bander, T.J.; Soldat, J.K. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight). Mar 1987. Contract AC06-76RL01830. 311p. (PNL—5907). NTIS, PC E12/MF A01 - GPO. File Number TI87011019.

This report describes the computer program GASPAR II used by the staff of the US Nuclear Regulatory Commission to perform environmental dose analyses for releases of radioactive effluents from nuclear power plants into the atmosphere. The analyses estimate radiation dose to individuals and population groups from inhalation, ingestion (terrestrial foods), and external-exposure (ground and plume) pathways. The calculated doses provide information for National Environmental Policy Act (NEPA) evaluations and for determining compliance with Appendix I of 10 CFR 50 (the "ALARA" philosophy). The report also instructs the user in preparing input to the program, describes the mathematical models that are used, and supplies detailed information on program structure and parameters used to modify the program. 20 refs., 11 figs., 77 tabs.

37932 (PNL-SA—14190) **Microdosimetric basis for exposure limits.** Brackenbush, L.W.; Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 19p. (CONF-861044—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011156.

From Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

The new organ-weighted effective dose equivalents should provide a much more accurate estimation of the degree of hazard for a worker's exposure to ionizing radiations. The method involves the microdosimetric concept of lineal energy to help establish exposure limits and will provide a unified system applicable to all types of ionizing radiation. Rather than being only calculated values, the effective dose equivalents and quality factors will be experimentally measured using tissue equivalent proportional counters. The measurement may be difficult to perform at various depths in an anthropomorphic phantom. Operational health physicists will be concerned about the lack of survey instruments and personnel dosimeters that measure lineal energy distributions. Their possible objections may be mitigated by the commercial introduction of instruments based upon tissue equivalent proportional counters or related devices containing inexpensive microprocessors. The many potential benefits include providing a uniform method for implementing the proposed increases in quality factors for neutrons and photons, providing a more unified approach for combining external and internal exposures, and potentially resolving questions about dosimeter placement and dose assessment for nonuniform exposures to mixed radiations. 16 refs., 3 figs.

37933 (RFP—4124) **Maintaining occupational review programs using the flow Gemini system.** Bistline, R.W. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jun 1987. Contract AC04-76DP03533. 30p. (CONF-8706126—1-Vugraphs). NTIS, PC A03. File Number DE87011050.

From Taiwan Power Company conference; Taipei, Taiwan (17 Jun 1987).

This document provides a topical outline with projected diagrams from an oral presentation given to the Taiwan Power Company conference in Taipei, Taiwan. The author describes medical, toxic compound, epidemiological, and industrial hygiene records maintained in the occupational review programs on a VAX 11/750 computer. He also lists the data bases and their component segments, physical examination criteria, health physics topics, and report formats that are used with the system. 7 figs.

37934 **The multicellular nature of radiation carcinogenesis.** Rossi, H.H.; Hall, E.J. (Dept. of Radiology, Columbia Univ., College of Physicians and Surgeons, New York, NY 10032). pp 359-368 of Radiation carcinogenesis: Epidemiology and biological significance. Boice, J.D.; Fraumeni, J.F. New York, NY; Raven Press (1984).

The authors propose that the commitment to transformation is made soon after irradiation - at least before the 7th day - and not after confluence as hypothesized by a previous study. Also, the number of foci per dish when cells are reseeded 1, 2, and 3 weeks after irradiation does not increase as rapidly as one would expect in view of the early commitment to the transformed state. This suggests a strong suppression of the expression of transformation.

37935 **Radium-dial workers.** Rowland, R.E.; Lucas, H.F. (Center for Human Radiobiology, Argonne National Lab., Argonne, IL 60439). pp 231-240 of Radiation carcinogenesis: Epidemiology and biological significance. Boice, J.D.; Fraumeni, J.F. New York, NY; Raven Press (1984). Contract W-31-109-ENG-38.

The population of radium-dial workers, which has now been studied for more than half a century, constitutes a resource of considerable value. More than 1,100 workers who were exposed to radium 30 to 50 years ago are currently being followed by the Center for Human Radiobiology at the Argonne National Laboratory. It is not clear that radium has induced additional malignancies in this population, other than the well-known bone sarcomas and head carcinomas, but elevated incidence rates for multiple myeloma and cancers of the colon, rectum, stomach, and breast suggest that radium might be involved. Continued follow-up of this population may resolve these questions.

## 5602 Thermal Effects

37936 **(CONF-8704145—1) Stopping biological time: The freezing of living cells.** Mazur, P. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010898.

From 5. world congress on in vitro fertilization and embryo transfer; Norfolk, VA, USA (8 Apr 1987).

The fundamental physical-chemical events that occur during the freezing and thawing of cells are outlined and the manner in which cell permeability determines the response of the cell to freezing is discussed both in terms of physical response and in terms of survival. 40 refs., 12 figs.

## 5603 Chemicals Metabolism And Toxicology

*REFER ALSO TO CITATION(S) 36367, 36476, 37604, 37605, 37706, 37870, 37928, 37929, 37933*

37937 **(BNL—39866) Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$.** Pounds, J.G.; Nye, A.C. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-8705124—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010790.

From TEMA-6: 6th international conference on trace elements in man and animals; Asilomar, CA, USA (31 May 1987).

Altered $Ca^{++}$ homeostasis may result from the direct inhibition of calmodulin-dependent or -independent transport processes. Changes in cell function not directly related to the transport of Ca, e.g., uncoupling of oxidative phosphorylation or altered membrane permeability also disrupt cell calcium metabolism. Thus, the effects of the calmodulin inhibitor W-13 on cell $Pb^{++}$ metabolism may be due to its direct effects on $Pb^{++}$ transporting $Ca^{++}$ pumps, or indirectly as a result of changes in $Ca^{++}$ homeostasis. Direct comparison of the effects of W-13 on the metabolism of Pb and Ca is impaired by differences in the kinetic distribution and behavior of Pb and Ca. A further complication is that the calmodulin-dependent processes are most active during periods of elevated intracellular $Ca^{++}$. The preliminary experiments reported here were conducted in unstimulated cells which have a low resting level of cytosolic $Ca^{++}$. Therefore, W-13 induced alterations in cell $Ca^{++}$ and $Pb^{++}$ may not reflect the changes which could occur in stimulated cells. 1 ref., 1 fig.

37938 (CONF-8508235—, pp 63-69) **Monitoring the modifications in the forest ecosystem of the Brazilian Amazon region through remote sensing techniques.** Carneiro, C.M.R. (Ministry of Agriculture, Brasilia, Brazil. Brazilian Inst. for Forestry Development). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

This paper describes the most important forest ecosystem of Brazil - the Amazon forest, its characteristics and main agents of spatial modifications and changes. It mainly explains how these modifications are being annually monitored through the Brazilian Forest Cover Monitoring Program of the Brazilian Institute for Forestry Development - IBDF - the forest service of Brazil.

37939 (CONF-8508235—, pp 223-228) **Thinning out of the tree crown - what is hidden in that integrated measure of forest damage.** Westman, L.; Lesinski, J. (Umeaa Univ., Sweden. Inst. of Ecological Botany; Agricultural Univ., Krakow, Poland. Forest Faculty). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

Thinning out of the crown is an easily observable measure for evaluation of tree vitality. For this reason it is extensively utilized for inventories in damaged spruce tree stands. However, the phenomenon involves a complex of differentiated symptoms of injury. The thinning out of a spruce crown under the influence of abiotic and biotic factors is a normal phenomenon closely connected to gradual aging. However, particular trees of the same age may show various stages of thinning out. Normal thinning out involves loss of the oldest needles and eventually drying and loss of the oldest lateral shoots. When the forest ecosystem homeostasis is imbalanced, for example, under the direct or indirect influence of air pollutants, the thinning out may develop more rapidly and begin even in the youngest parts of an individual branch. Particular kinds of lateral shoots play different roles during the process of thinning out. Thus the number and contribution in the living biomass of ordinary, adventitious and secondary shoots vary lengthwise along the branch as well as vertically within the crown. The interaction between branch destruction and secondary shoot development is presented to illustrate the complexity of the measure being discussed.

37940 (CONF-8508235—, pp 269-271) **Special inventories to record the state of health of forest in Hungary and its improvement.** Solymos, R. (Ministry of Agriculture and Nutrition, Budapest, Hungary). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

In Hungary several organisations are in charge of controlling and surveying the state of health of forests in coordination by the forestry inspection authorities. When a forest management facility is set up, the different harmful insects and adverse effects are pinpointed and recorded per forest plot. The investigation areas arranged in a grid of 4 x 4 kilometres mesh width provide a long-term inventory grid. They are completed by case-to-case surveys in the event of unexpected incidence of harmful insects. In the whole country, light traps are in operation to predict insect pest. In every region, research stations for forest protection and ecology are being set up or extended covering a whole range of ecological factors from the soil to air pollutants. Relations between wood increment and environmental effects are investigated at the level of nationwide areas for long-term study of timber yield. Data are stored by a central data bank which is at the disposal of forestry enterprises and the supreme national authority.

37941 (CONF-8508235—, pp 333-338) **Mathematical and statistical evaluations of needle analyses.** Becher, G. (Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg, Germany, F.R. Inst. fuer Weltforstwirtschaft). 1985. (In German). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752457.

From IUFRO conference on inventoring and monitoring endangered forests; Zurich, Switzerland (19 Aug 1985).

The contents of p-elements in one year old Norway spruce needles are considered as observations from a multivariate normally distributed random vector. To assess the quantitative differences in element contents of the needles between different sites, the linear discriminant analysis is proposed, mathematically derived and discussed. Apart from the problem of describing the complicated correlation structures of element contents, there are difficulties in interpreting and reducing parameters describing them. Using the exponential family of normal distributions for parameter representation the covariance selection as a procedure for analysis of correlation structure is discussed.

37942 (CONF-8608141—, pp 59-69) **Increasing net primary productivity in Washington (USA) forests during the last 100 years.** Graumlich, L.J.; Brubaker, L.B. (Univ. of California, Los Angeles). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Evidence of 20th-century increases in atmospheric $CO_2$ and global temperatures has prompted interest in the effects of these factors on the productivity of terrestrial vegetation and in the role of vegetation in sequestering atmospheric $CO_2$. The authors compare the temporal course of net primary productivity of forest stands in western Washington with records of $CO_2$ and climate. Annual estimates of net primary productivity extending back to 1880 indicate that productivity has increased 60% during the 20th century. Annual production is significantly correlated with long-term variation in summer temperature and short-term variation in annual precipitation. Production is uncorrelated with atmospheric $CO_2$ concentrations, suggesting that direct $CO_2$ fertilization is currently unimportant in these forests. 15 references, 3 figures, 1 table.

37943 (CONF-8608141—, pp 353-359) **Southern forest growth trends: air pollution influence studies and tree-ring analysis.** Dell, T.R. (Dept. of Agriculture). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Allegations of decline in forest health related to atmospheric pollution in the southern US have prompted new research programs. This is a summary of the opportunities and motivation for research on atmospheric pollution influences of the commercial forest production of the southern US. The overview will be limited to retrospective field studies, with trees in a forest setting rather than the more controlled dose-response circumstance in various types of growth chambers. For studies involving trees grown in a natural state, forest growth and yield methods and data bases are likely to play a significant role. Furthermore, this is the category where tree-ring analysis is being employed, and there are opportunities for combining approaches from the two disciplines. Hopefully the controlled condition studies and processes of extrapolating results to actual forests will evolve and be linked with sets of plots designed for future monitoring. However, at the present time, data taken from past studies or tree-rings must be utilized to provide initial guidance. 7 references, 1 figure, 1 table.

37944 (CONF-8608141—, pp 372-381) **Growth-rate trends of pines since 1930 in the northeastern United States.** Whiton, J.C. (Geological Survey). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Long-term radial growth rates of white, pitch, and shortleaf pines in the northeastern United States were calculated and examined for evidence of growth trends that are coincident with changing atmospheric pollution levels in the last half-century. Growth rates were determined in terms of changes in annual ring area. Growth rings of more than 800 trees in thirteen states were analyzed. White pine shows the greatest growth rates, pitch pine the lowest. Pitch pine sampled on two sites near a rayon-producing factory in Virginia show severe decline less than ten years after the factory began operating in 1939. These pitch pine collections showed much lower growth rates since 1950 than any other collection of trees. Some pitch pine and shortleaf pine collections had negative growth rates at some time between 1930 and 1980, unlike white pine. Most of these reduced growth rates were after 1985. Changes in growth trends are neither synchronous nor parallel for pines throughout the northeast, nor does any clear pattern of decline exist within regions of the northeast. Growth trends are probably most reflective of climatic trends. 13 references, 5 figures.

37945 (CONF-8608141—, pp 392-400) **Tolerance and susceptibility to air pollution, a new direction in sampling strategy: a case study of Pinus strobus L. in Acadia National Park, Maine.** Treshow, M.; Sutherland, E.K.; Bennett, J.P. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In this study, the authors use an alternate sampling strategy to assess the effects of a region-scale air pollution on tree growth, before visible injury symptoms have appeared. Genetic variability in susceptibility to pollutants such as ozone has long been described in herbaceous and woody plants. If a stand of trees at a site can be stratified into groups of trees relatively tolerant and susceptible to an air pollutant, then the tolerant trees may be used as a control group to compare to the stressed group. The limitation of this method is of course that the tolerant trees are still incurring some damage, and the assessment of air pollution effects will be conservative. However, the problem of comparison of site separated by distance is entirely eliminated, and analytic methods to compare growth of the two groups may be quite simple. The authors case study examines the effect of ozone on the radial growth of eastern white pine (Pinus strobus L.) trees in Acadia National Park, Maine, stratified into two groups of sensitivity based on foliar symptoms. 27 references, 1 figure.

37946 (CONF-8608141—, pp 402-409) **Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California.** Peterson, D.L.; Wakefield, V.A.; Arbaugh, M.J. (Dept. of Agriculture, Riverside, CA). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Jeffrey pine growth at sites with symptoms of ozone injury was compared to growth at sites without ozone injury at Sequoia and Kings Canyon National Parks, California. Growth index was 11% less in exposed trees than controls since 1965. Trees $>40$ cm diameter and $>100$ years old had larger growth reductions than smaller and younger trees. Regression analysis indicated that winter precipitation accounted for a large proportion of a variance in the growth of all trees. Ozone-stressed trees were more sensitive to variation in precipitation and temperature during recent years. These results are the first evidence of forest growth reduction associated with ozone injury in western North America outside the Los Angeles Basin. 12 references, 3 figures, 1 table.

37947 (CONF-8608141—, pp 410-416) **Dendroecological analysis of ambient sulfur dioxide effects in western larch.** Kincaid, W.B. (Arizona State Univ., Tempe). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Dendroecological methods were used to determine the responses in radial growth of western larch (Larix occidentalis Nutt.) to ambient $SO_2$ exposure. A unique, 32-year long record of ambient $SO_2$ concentrations was exploited to estimate annual $SO_2$ dose with a 0.25 ppm threshold. Tree-ring data were a subset from a previous study including three control sites and one polluted site, which was downriver from the monitor location, but close enough that exposure estimates were reasonable. An autoregression model was employed in a stagewise procedure that first removed climate effects by autoregression on the average of the controls and then estimated a dose-response relationship by autoregression of the residuals from the first stage on $SO_2$ exposure. Significant growth losses from air pollution were demonstrated that were approximately equal in magnitude to the variation explained by annual fluctuations of climate. 7 references, 3 figures.

37948 (CONF-8608141—, pp 451) **Potential physiological and ecological effects of increasing $CO_2$ on forests.** Strain, B.R. (Duke Univ., Durham, NC). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Atmospheric $CO_2$ is increasing and a concensus has emerged that global greenhouse warming is underway. Carbon dioxide induced climate change will undoubtedly affect the productivity and distribution of forests. The direct biological effects of $CO_2$ increase, however, are uncertain. Basically, $CO_2$ is a plant fertilizer. Photosynthesis, plant growth and development rate, growth form, nutritional status of plant tissues, and tolerance to environmental stress have all been shown to be affected by increase in atmospheric $CO_2$

concentration. Differential species responses to a given level of $CO_2$ increase, however, make it impossible to predict how multiple species ecosystems like forests will respond to $CO_2$ increase. In addition to uncertainties associated with ecological complexity, little physiological information exists for trees grown for long periods of time under $CO_2$ enrichment. Thus, the authors do not known how short term responses observed in most $CO_2$ experiments will be accumulated and integrated through time in perennial forest ecosystems. This paper will enumerate known plant and ecosystem responses to long-term $CO_2$ enrichment and will speculate on forest tree and forest ecosystem responses expected in coming decades.

37949 (CONF-8608141—, pp 452-462) **Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth.** Kienast, F. (Oak Ridge National Lab., TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045. Contract AC05-84OR21400.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Relationships among weather conditions, site elevations, site characteristics, and ring formation on trees growing along altitudinal transects were investigated. Thirty-four chronologies from four different climatic regions with a wide range of site conditions were analyzed with radiodensitometric methods. A graphical technique of data representation was developed to analyze the tree-ring pattern on a single-year basis. Typical examples are presented and the dynamics of the overlapping environmental influences are discussed. The broad spectrum of site conditions was used to identify ring parameters and site types most suitable for reconstruction of temperature or precipitation records. Additionally, the transects served as an ideal data base to test the theory of a possible growth enhancement caused by increased atmospheric carbon dioxide. Results show a growth increase (mainly in the ring widths) in about 25% of all chronologies during the last three decades. In most of the cases the increase is related to a specific site type, influenced only slightly by climatic stress. Sensitive chronologies with heavy climatic stress and complacent series did not show the increase. However, more favorable climatic conditions were found to coincide with this increase in more than 60% of all the chronologies that showed increased growth. Higher $CO_2$ levels could have contributed to an increase in 10 to 15%, at the most, of the 34 chronologies. 20 references, 2 figures, 1 table.

37950 (CONF-8608141—, pp 463-474) **Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide.** Graybill, D.A. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

It is well documented that many agricultural crops and woody plants exhibit enhanced yield or growth when subjected to increased $CO_2$ concentrations under controlled conditions. Given the increase in atmospheric $CO_2$ since the mid 19th century there are a considerable number of questions about the timing, locations and nature of native plant growth response that might occur under ambient conditions. Long tree-ring series that are climatically sensitive and that may also contain a $CO_2$ growth response provide one basis for consideration of those questions. Ongoing research designed to develop a network of tree-ring chronologies in the western US that can be used to examine tree-ring growth response to changing $CO_2$ and climatic parameters is summarized. Current sampling is designed to cover most of the Great Basin and the Southwestern US, focusing on long-lived species growing under stressful climatic conditions and at elevations where a $CO_2$ signal might be most apparent. 19 references, 3 figures.

37951 (CONF-8608141—, pp 494-500) **Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes.** Telewski, F.W.; Strain, B.R. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Trees of Pinus taeda and Liquidambar styraciflua were grown from seed and treated for three years at 350, 500 and 650 ppm $CO_2$. Water stress was applied to one half of the plants in years 2 and 3. The twelve treatment groups were harvested and measurements were made to total stem diameter, ring width and wood density. In all treatment groups, increased $CO_2$ increased stem diameter. Individual ring widths also increased with increase in $CO_2$, the trend being clearer in Liquidambar styraciflua. There is no change in latewood density of L. styraciflua with $CO_2$ treatment. There was an apparent increase in latewood density in water stressed saplings compared with non-stressed saplings which is independent of $CO_2$ treatment. An apparent increase in latewood density was observed in P. taeda, especially in the last growth ring. Because of the great increase in individual ring widths in L. styraciflua the total ring biomass (integral density) increases with $CO_2$ treatment in well watered trees but decreases with drought. A similar trend was observed in the intergral density in P. taeda. No significant changes were observed in average density between any treatment group for either species. It is suggested that, at least for 3 year old saplings, ring width and integral density are more sensitive indicators of increased $CO_2$ under both drought and non-drought conditions than latewood maximum density or average ring density. 8 references, 5 tables.

37952 (CONF-8608141—, pp 501-510) **Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions.** Doyle, T.W. (Oak Ridge National Lab., TN). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045. Contract AC05-84OR21400.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Loblolly pine and sweetgum seedlings were obtained from a Duke University phytotron study, where three groups were grown in different atmospheres of $CO_2$ (i.e., 350, 500, 650 ppmv). Seedlings were grown over three growing seasons, and included a set of water-stressed and non-stressed individuals. X-ray densitometry was used to evaluate growth and density characteristics of the wood samples. Cross-sectional discs of these samples were radiographed and scanned with a microdensitometer to determine ring width, area, density and mass for each growth year. Results indicated significant differences in wood production (ring width, area and mass) between the lowest treatment of $CO_2$ (350 ppmv) and the higher concentration (500 and 650 ppmv) treatments. While only a few density parameters demonstrated significant changes with increasing $CO_2$, almost all showed a systematic increase in density with increasing $CO_2$ concentration. Ring area and mass displayed the greatest degree of change between treatments. Induced drought effects appeared only to strengthen the $CO_2$-growth association. These findings suggest that naturally stressed trees are also likely to exhibit some growth effect with increasing atmospheric $CO_2$. And because the greatest margin of response existed between 350 and 500 ppmv, this study emphasizes the importance and need to determine growth responses at preindustrial era $CO_2$ concentrations in order to more accurately identify the postulated fertilizer effect on modern forests. 10 references, 4 tables.

37953 (CONF-8608141—, pp 511-521) **Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide.** Parker, M.L. (M.L. Parker Co., Inc., Vancouver, British Columbia). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Atmospheric $CO_2$ has increased from a preindustrial level of from 250 to 290 parts per million to a current level of about 345 ppm. It is expected to double at some time in the 21st century. Increased levels of $CO_2$ have been shown to increase tree growth under controlled conditions. Some forest trees may respond to increased $CO_2$ with increases in ring width, but this effect may be obscured by other environmental influences at some sites. Ring width values of Douglas-fir trees from a moist British Columbia site show a marked increase during the past few decades. Environmental influences other than increased $CO_2$ have not been found that would explain this. Pronounced growth increase during the last few decades is not present for Douglas-fir from the dry British Columbia interior. Raw ring width values were examined for the individ-

ual radii of trees from 17 sites in Canada and the northwest US. For the period after 1920, 7 sites show greater ring-width growth than would be expected if age were the only factor influencing growth. There is enough evidence to conclude that increased atmospheric $CO_2$ as well as other environmental factors, can affect forest growth. The authors should now determine the extent of that effect. 18 references, 7 figures, 3 tables.

37954 (CONF-8608141—, pp 579-590) **Time-dependent responses of trees to weather variations an application of the Kalman filter.** Visser, H.; Molenaar, J. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

To find effects of air pollution in ring-width series it is important to filter out the influence of the weather. In this paper the method of response functions is made more flexible by application of the Kalman filter technique. The filter allows for changes in the response of trees to weather variations over time. The Kalman filter is described in short, and applied to simulated as well as real ring-width series. It is suggested that time-dependency of response functions could be an air pollution phenomenon. 22 references, 6 figures.

37955 (CONF-8608141—, pp 591-598) **Tree-growth, ARMA modelling and pollution.** Serre-Bachet, F. (Universite Aix-Marseille III, France). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The slopes of the Arc-Mauriene Valley in France have been exposed to an increasing fluoride pollution since the beginning of the century. This diameter growth of four coniferous species in analyzed here. Preliminary results on spruce (Picea excelsa Link) show a parallelism between sensitivity to climate and pollution. The ARMA modelling procedure has been used to evidence relationships between tree rings and climate. 30 references, 3 figures, 2 tables.

37956 (CONF-8608141—, pp 690-698) **History of the chemical environment from elemental analysis of tree rings.** McClenahen, J.R.; Vimmerstedt, J.P.; Lathrop, R.C. (Ohio State Univ., Columbus). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Studies are underway to assess the feasibility of reconstructing historical changes in the chemical environment of forests, specifically in relation to airborne pollutant deposition, from time series of elemental concentrations in annual rings of trees. Objectives pertinent to this report were: (1) To assess the statistical variability of element profiles within annual rings and within and among trees on a site and, (2) To determine the effect of changing soil chemistry on element concentrations in annual rings. Additional studies will address the potential for lateral element transport, effects of soil type, ring width, and climate on xylem element concentrations, and the sensitivity of element concentrations to different pollutant deposition gradients. 2 figures, 2 tables.

37957 (CONF-8611165—1) **Feasibility of field detection and analysis of the toxic products of combustion.** Zaromb, S.; Buttner, W.J.; Stamoudis, V.C.; Domin, D.; Privette, J. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011353.

From Annual conference on fire research; Gaithersburg, MD, USA (3 Nov 1986).

This work evaluates the applicability of chemical parameter spectrometry (CPS) and allied techniques to the design and construction of an instrument for the detection and analysis of the toxic products of combustion. The capability sought in the near term is field detection and selective quantitation of at least five toxic compounds of primary interest in the presence of other combustion products. Ultimately, the instrument will provide analyses of all or most of the toxic products formed during combustion that present a danger to human health. CPS consists of measuring a number of different chemical parameters obtained from sensor responses to a given analyte and thus developing a characteristic response pattern or parameter spectrum. A comparison of that spectrum with previously determined parameter spectra for a variety of compounds may then permit identification of an unknown compound in the analyte. The fundamental problem is to determine how CPS can be usefully applied to the identification of toxic components in complex gaseous mixtures of possibly 20 or more compounds. This problem has been addressed, after reviews of the instrument design goals and of the potentially usable instrumental techniques, by the extension of the capabilities of CPS to mixtures of up to three or four detectable compounds, and fractionation of complex combustion product mixtures into simpler mixtures of not more than three or four of such compounds. 2 refs., 1 fig.

37958 **(GSF—37/86) Documentation of publications on the subject of forest damage. As of July 1986.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)). Oct 1986. 529p. (In German). NTIS, PC E99; Available from NTIS as TIB/B87-07076.

The 1912 citations (as of July 1986) are listed in alphabetic order according to the first-named author. Each citation comprises the consecutive number, the author, title, corporate source, and index terms. In the alphabetic subject index, the index terms are listed along with the number of the citation. This permits simple bibliographic searches even without the aid of a computer.

37959 **(LA-UR—87-1748) Work performance evaluation using the exercising rat model.** Stavert, D.M.; Lehnert, B.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870887—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010131.

From 6. medical chemical defense bioscience review; Baltimore, MD, USA (1 Aug 1987).

A treadmill-metabolic chamber system and a stress testing protocol have been developed to evaluate aerobic work performance on exercising rats that have inhaled toxic substances. The chamber with an enclosed treadmill provides the means to measure the physiologic status of rats during maximal work intensities in terms of $O_2$ consumption ($V_{02}$) and $CO_2$ production (V/sub c02/). The metabolic chamber can also accommodate instrumented rats for more detailed analyses of their cardiopulmonary status, e.g., ECG, cardiac output, arterial blood gases and pH, and arterial and venous blood pressures. For such studies, an arterial/venous catheter preparation is required. Because of the severe metabolic alterations after such surgery, a post surgical recovery strategy using hyperalimentation was developed to ensure maximal performance of instrumented animals during stress testing. Actual work performance studies are conducted using an eight minute stress test protocol in which the rat is subjected to increasing external work. The metabolic state of the animal is measured from resting levels to maximum oxygen consumption (V/sub 02max/). V/sub 02max/ has been shown to be reproducible in individual rats and is a sensitive indicator of oxidant gas-induced pulmonary damage. 3 tabs.

37960 (LMF—115, pp 83-86) **Deposition of ultrafine particles on a human nasal cast.** Cheng, Y.S.; Yeh, H.C.; Swift, D.L. (John Hopkins Univ., Baltimore, MD). Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

This report describes an experimental study of aerosol deposition in a nasal cast. A clear polyester resin cast of the upper airways of a normal human adult was made from a post-mortem negative cast. This life-sized model includes nasal hairs, the nasal airways, nasopharynx and larynx. The measured pressure drop in the cast was similar to the in vivo measurements reported in the literature. The authors measured the total deposition in the cast for monodisperse NaCl aerosols of 0.2 to 0.003 $\mu$m diameter at flow rates between 4 to 60 L/min inspiratory flow. The deposition efficiency increased with decreasing particle size and flow rate, indicating that diffusion was the dominant mechanism. At 20 L/min flow (near the normal breathing flow rate) deposition efficiencies reach 11 and 25% for 0.01 and 0.004 $\mu$m particles, respectively. Their data show that considerable deposition occurs for ultrafine aerosols and this

information should be incorporated into future regional deposition models. 5 references, 3 figures.

37961 (LMF—115, pp 87-90) **Technique for aerosol deposition restricted to the nose in Beagle dogs.** Wolff, R.K.; Whaley, S.L.; Renken, S.; Muggenburg, B.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

To aid in better understanding the mechanisms of deposition of particles in the nasal cavity, a method was developed for exposing the nasal cavity of Beagle dogs to a radiolabeled aerosol without exposure of the remainder of the respiratory tract. Deposition efficiency, using a test aerosol of 2.0 μm particles of /sup 99m/Tc-sulfur colloid delivered to the nose, was 15 +/- 2% (mean +/- SE). Maximum deposition occurred in the anterior third of the nasal cavity which contained 78 +/- 4% (mean +/- SE) of the total deposited radioactivity. The middle third of the nasal cavity received 13 +/- 3% and the posterior third 9 +/- 2% of the deposited radioactivity. Gamma camera scintiphotographic imaging detected no aerosol deposited in the lower respiratory tract. 5 references, 1 figure, 1 table.

37962 (LMF—115, pp 91-95) **Model for deposition and long-term disposition of $^{134}$Cs-labeled fused aluminosilicate particles inhaled by guinea pigs.** Snipes, M.B.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

When considering which laboratory animal species to use in inhalation studies, it is important to evaluate the similarities and differences in deposition and fate of the inhaled materials in various laboratory animals compared with humans. Beagle dogs have deposition and clearance patterns of inhaled particles similar to humans. However, some studies require smaller laboratory animals to be cost effective or to allow an adequate number of animals to address the scientific questions. This study evaluated the deposition and clearance of a relatively insoluble aerosol inhaled by guinea pigs. The test aerosol was monodisperse $^{134}$Cs-labeled fused aluminosilicate particles inhaled during 75 minute inhalation exposure. The guinea pigs had deposition similar to rats but respiratory tract retention and clearance patterns were similar to dogs and humans. 5 references, 2 figures, 1 table.

37963 (LMF—115, pp 96-100) **Comparative simulated lung burdens of dust in rats, guinea pigs, and dogs with chronic inhalation exposures.** Snipes, M.B. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Different species of laboratory animals have characteristic patterns of deposition, retention, and clearance for inhaled materials. Minute respiratory volume, pulmonary deposition fraction for the inhaled material, and clearance parameters influence these patterns. Simulation models using deposition and clearance parameters based on the results of single, acute inhalation exposures were used to make projections for lung burdens accumulated by rats, guinea pigs, and dogs chronically exposed 8 h/day, 5 days/week for 2 years. Results indicate there would be a three-fold difference among these species in the mass of accumulated particles per gram of lung at the end of two years of chronic exposure to the same aerosol. The largest lung burdens would be observed in dogs, the smallest in rats. Conversely, to reach the same target lung burden of particles would require about a three-fold difference in air concentrations of the exposure material. These simulations are useful for helping select the appropriate laboratory animal species to study, for defining aerosol concentrations to use, and for making approximations for lung burdens which would result for defined exposure scenarios. 4 references, 3 figures, 1 table.

37964 (LMF—115, pp 101-104) **Translocation of particles by macrophages from lung to lymph nodes of rats.** Harmsen, A.G.; Gillett, N.A.; Stegelmeir, B. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Rats were instilled intratracheally with 5 x 10$^9$ fluorescent microspheres (1.3 μm diameter) and were killed in groups at 1, 2, 4, and 8 days later. Plastic sections of the tracheobronchial lymph nodes (TBLN) demonstrated that approximately 90% of the translocated microspheres were within macrophages. In addition, the distribution of the numbers of microspheres per TBLN macrophage did not change even though total microspheres in the TBLN increased with time. This suggests that the microspheres arrived at the TBLN within macrophages. To confirm this observation the authors instilled rat lung macrophages, labeled with fluorescent microspheres, into the lungs of syngeneic recipients. Three days later the recipient's TBLN contained labeled macrophages. These results indicate that the macrophages had migrated from the lung to the TBLN and had translocated microspheres in the process. 4 references, 2 figures, 1 table.

37965 (LMF—115, pp 114-120) **Toxicokinetics of beryllium following acute inhalation of BeO by beagle dogs: a status report.** Finch, G.L.; Mewhinney, J.A.; Hoover, M.D.; Harmsen, A.G.; Haley, P.J.; Eidson, A.F.; Bice, D.E. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs were given a single inhalation exposure by nose to radiolabeled beryllium oxide ($^7$BeO) calcined at either 500 or 1000°C for 16 h. Either high (average value 50 μg BeO/kg body weight) or low (average value 17 μg BeO/kg) initial lung burdens (ILBs) were achieved. Whole body, tissue and excreta Be levels were quantified by external gamma-ray counting. Sacrifices were conducted at 8, 32, 64, and 180 days after exposure to examine Be distribution in the tissues. Tissue Be concentrations (normalized to ILB) were independent of the level of ILB. Beryllium oxide calcined at 500°C was cleared more rapidly from the lungs (85% of the ILB cleared at 180 days after exposure) compared with BeO calcined at 1000°C (43% of the ILB cleared at 180 days after exposure). Beryllium cleared from the lungs and not excreted was translocated mostly to the carcass (primarily in bone), tracheobronchial lymph nodes, liver, and blood. The sacrifice of additional dogs in this study is planned for one and two years after exposure. 7 references, 2 figures, 4 tables.

37966 (LMF—115, pp 121-124) **Rapid method for determining soot content of lungs in diesel-exposed rodents.** Henderson, R.F.; Waide, J.J.; Mauderly, J.L.; McClellan, R.O. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Knowledge of the quantity of inhaled material present in the lung provides a better measure of the dose than does the concentration of airborne materials for making inter-species extrapolations of data on the toxicity of airborne materials. To this end, a rapid optical method for determining the quantity of soot in the lungs of rodents exposed to diluted diesel exhaust has been developed. The method is nondestructive to enzymatic components of the lung, allowing dose and biochemical assay to be done on the same sample. The lung burdens of soot were determined by comparing the extinction of light at 620 nm of lung homogenates from exposed animals to that of lung homogenates containing spiked standards. 6 references, 1 figure, 1 table.

37967 (LMF—115, pp 125-129) **Lung retention of inhaled $^{14}$C-BaP and $^{14}$C-NP when adsorbed on carbon particles.** Wolff, R.K.; Sun, J.D.; Barr, E.B.; Rothenberg, S.J.; Yeh, H.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Studies were conducted to evaluate the influence of particle association of polycyclic aromatic hydrocarbons on their retention in the respiratory tract. Vaporization and condensation of premixed powders dispersed from a Wright dust feeder were used to produce submicron aerosols of 2% (by mass) $^{14}$C-benzo(a)pyrene (BaP) or 2% $^{14}$C-nitropyrene adsorbed on carbon black (CB). There was close correspondence of the particle size distributions of the $^{14}$C radiolabel, specific for the organic compounds, and the total mass,

representative primarily of the carbon black particles. Following 2 h nose only exposure of rats to these aerosols, lung retention of $^{14}C$ was biphasic. Percentages in the long-term retention component (1.2%. for $^{14}C$-BaP-CB and 3.7% for $^{14}CC$-NP-CB) were much greater than those previously measured for aerosols of the organic compounds alone (0.014% for $^{14}C$-BaP and 0.065% for $^{14}C$-NP). The amount of $^{14}C$ covalently bound to lung macromolecules (as a percentage of inhaled activity) were also much greater for the BaP-CB and NP-CB than for the pure compounds. These data suggest that adsorption of BaP and NP on carbon black enhances interactions with target molecules. 4 references, 4 figures, 1 table.

37968 (LMF—115, pp 130-134) **Factors affecting lung retention of $^{14}C$-benzo(a)pyrene adsorbed on carbon black particles.** Sun, J.D.; Maio, S.M.; Wolff, R.K. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Increased retention of inhaled benzo(a)pyrene (BaP) in lungs when adsorbed to insoluble particles was previously shown. In these studies, male F344 rats were intratracheally instilled with different amounts of $^{14}C$-BaP adsorbed onto carbon black particles at different percentages (0.2%, 2.0% or 20% BaP by mass) or with different amounts of $^{14}C$-BaP not on particles. Clearance of $^{14}C$ from lungs occurred in two phases. The fraction of $^{14}C$ in the long-term component of clearance increased as the percent of adsorbed BaP decreased, but did not change with differing amounts of carbon black particles having the same BaP coating. $^{14}C$ covalently bound to lung macromolecules was greater for the BaP on carbon black particles than for the instilled BaP not on particles. These data indicate that for the same mass of BaP instilled, greater lung retention occurred for the BaP instilled on carbon black. Also, as a percentage of the initial lung burden, retention of particle associated BaP is increased as the amount of BaP adsorbed onto particles is decreased. This increased lung retention may be indicative of the slow leaching of BaP from particles which may allow a larger fraction of this compound to be metabolized to reactive intermediates, rather than being cleared as parent compound. Thus, particle association of organic compounds may not only increase their retention in lungs, but may also increase their toxic/carcinogenic potential by binding to target macromolecules. 5 references, 3 figures, 2 tables.

37969 (LMF—115, pp 135-139) **Physiologically based model 1-nitropyrene metabolism.** Medinsky, M.A.; Hunsberger, S.; Griffith, W.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Nitropyrene (NP), a potent bacterial mutagen and a mammalian carcinogen, is a ubiquitous environmental pollutant. A model for the disposition of orally administered NP was constructed using published values for organ volumes and blood flow to organs. Studies in rats suggested that the important organs for NP accumulation after gavage were liver, kidney, and gastrointestinal tract. All other tissues were combined into a single compartment. Model predictions for concentration of NP and metabolites in tissues was compared to experimentally determined data obtained in rats given NP by gavage. The model adequately predicted NP concentrations in liver and the general tissue pool. The concentrations in the kidney were underestimated suggesting that macromolecular covalent binding of metabolites to kidney macromolecules was not adequately considered in the present model and should be incorporated into future revisions of the model. 6 references, 1 figure, 3 tables.

37970 (LMF—115, pp 140-150) **Model analysis of respiratory tract clearance of particles inhaled by people.** Cuddihy, R.G.; Yeh, H.C. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

A mathematical model is described for projecting the deposition and clearance of insoluble particles inhaled by people. The tracheobronchial region is represented by a series of airways having dimensions of a typical lung pathway as determined from measurements on human lung casts. Effective particle clearance velocities in the airways were calculated from measurements of short-term thoracic clearance of radiolabeled particles inhaled by people. These velocities range from 5 mm/min in the trachea to 0.001 mm/min in the terminal bronchioles. Movement of particles from the pulmonary region to the tracheobronchial airways is represented by a daily fractional clearance rate that decreases from $6 \times 10^{-3}$ immediately after inhalation to a constant value of $1 \times 10^{-3}$ beyond 200 days after inhalation. Projections of the model compare favorably with corresponding measurements of respiratory tract clearance in human subjects who inhaled aerosols of different sizes while using different breathing patterns. 23 references, 5 figures, 2 tables.

37971 (LMF—115, pp 283-285) **Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts.** Pickrell, J.A.; Good, D.J.; Benson, J.M.; Brooks, A.L.; Henderson, R.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

In order to study mechanisms underlying the cellular-molecular bases of collagen regulation in the lung, pulmonary alveolar macrophages (PAMs) were incubated with control media and media containing a known fibrogenic agent, nickel subsulfide, at varied concentrations. When conditioned media from unexposed PAM was co-cultured for 3 h with human lung fibroblasts growing on a collagen gel subphase, there was an approximate 30% reduction in fibroblast DNA. Neither collagen synthesis nor digestion of the collagen gel by the fibroblasts were affected by the products from unexpected PAM. Exposures of fibroblasts to conditioned media from nickel-exposed PAM increased the amount of DNA in the cultures (25 to 120%) relative to that of fibroblasts treated with media from unexposed PAM. Conditioned media from nickel-exposed PAM also decreased collagen synthesis and digestion of collagen gel by the fibroblasts. These data suggest that conditioned media from PAM cultures exposed to nickel stimulated proliferation of growing lung fibroblasts and reduced their collagen metabolism. 8 references, 1 table.

37972 (LMF—115, pp 286-290) **Cytotoxicity of beryllium compounds to cultured canine alveolar macrophages.** Finch, G.L.; Verburg, R.J.; Mewhinney, J.A.; Eidson, A.F.; Hoover, M.D.; Harmsen, A.G. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Pulmonary alveolar macrophages (PAM) obtained by bronchopulmonary lavage from Beagle dogs were exposed in vitro to beryllium sulfate ($BeSO_4$) or beryllium oxide (BeO) calcined at either 500°C or 1000°C. Biological endpoints quantified included cell viability (determined by trypan blue dye exclusion) and Fc receptor-dependent phago-cytosis (determined by measuring uptake of sheep red blood cells). In the cell viability assay, the most toxic material tested was $BesO_4$, followed by BeO prepared at 500°C, then BeO prepared at 1000°C. Similarly, $BeSO_4$ was more effective in inhibiting PAM phagocytosis of SRBC compared with BeO prepared at 1000°C. Reduced phagocytosis was observed at concentrations at least ten times lower than that required to cause cell killing for all Be compounds tested. This suggests that PAM phagocytosis is more sensitive than viability as an indicator of toxic effects resulting from beryllium exposure. 4 references, 2 figures.

37973 (LMF—115, pp 291-295) **Lung cellular response and lymphocyte blastogenesis.** Harmsen, A.G.; Finch, G.L.; Mewhinney, J.A.; Muggenburg, B.A.; Bice, D.E. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Beagle dogs inhaled aerosols of BeO calcined at 500°C or 1000°C. The initial pulmonary depositions of BeO ranged from 17 to 76 μg BeO per kg body weight. Bronchoalveolar lavage was performed on the exposed dogs at 30, 60, 90, 180, and 210 days. A greater pulmonary neutrophilic and lymphocytophilic response was found to the 500°C-treated BeO as compared to the 1000°C-treated BeO. The dogs exposed to 500°C-treated BeO had lung and peripheral blood lymphocytes that proliferated in vitro following exposure to $BeSO_4$. Only a few of the dogs exposed to 1000°C-treated BeO exhibited peripheral blood lymphocyte responses. These re-

sults suggest that pulmonary deposition in the range of 50 μg BeO per kg body weight calcined at 500°C can induce hypersensitivity lung disease in dogs. It appears that the dog may be a good model for studying Be-induced lung disease. 5 references, 2 figures, 2 tables.

37974 (LMF—115, pp 296-301) **Possible role of reduced glutathione in the development of pulmonary fibrosis.** Sun, J.D.; Pickrell, J.A.; Harkema, J.R.; McLaughlin, S.I.; Henderson, R.F.; Hahn, F.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The capacity of reduced glutathione (GSH) to protect against ozone-induced pulmonary fibrosis was investigated. Mice were exposed to 0, 0.2, 0.5 and 1.0 ppm ozone for 23 h/day for 14 days. During exposures and/or for a period of 90 days after exposures, sub-groups of mice at each exposure level were given drinking water containing 30 mM L-buthionine- S,R-sulfoximine (BSO) to lower in vivo levels of GSH. BSO treatments reduced lung GSH levels by ~50% in all groups. In contrast, ozone exposures increased lung GSH levels in a concentration-dependent manner that was independent of the effects elicited by BSO treatments. Immediately after exposures, an ozone related inflammatory response was seen in the lungs, but no signs of developing fibrosis were evident. However, 90 days later, mice exposed to 1 ppm ozone and treated with BSO during this post-exposure period (regardless of BSO treatment during exposures) showed increased total lung collagen and histopathological evidence of pulmonary fibrosis. These results indicate that lung GSH levels during the tissue-repair period rather than during the time of initial lung injury are important for protection from ozone-induced pulmonary fibrosis. 4 references, 3 figures, 1 table.

37975 (LMF—115, pp 302-305) **Effect of time of glutathione depletion on ozone-induced pulmonary fibrosis.** Kirkpatrick, D.T.; Sun, J.D.; Harkema, J.R.; Pickrell, J.A.; Henderson, R.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Exposure to 1 ppm ozone ($O_3$) (14 days, 23 h/day) causes pulmonary fibrosis in mice treated for 90 days after exposure with the tissue glutathione (GSH) decreasing agent, buthionine sulfoximine (BSO). To study the time period during which GSH affects development of fibrosis, male $B6C3F_1$ mice were exposed to $O_3$ and given 30 mM BSO in drinking water for 7, 14, 21 or 90 days after exposure. Lung non-protein sulfhydryl (NPSH), as an estimate of GSH, decreased by ~ 50% in all BSO treatment groups, compared to identically exposed control groups. A 160% increase in lung NPSH induced by $O_3$ was reduced to 75% of normal by a 7-day BSO treatment. Control mice exposed to $O_3$ had no fibrotic changes at 90 days post-exposure, but all mice that received BSO for 7, 14, 21 or 90 days after exposure had areas of interstitial, alveolar duct-associated fibrosis. The decrease in GSH caused by BSO treatment as short as one week post-exposure led to histologically observable fibrosis in mice exposed to $O_3$. The first 7 days following exposure to ozone appears to be a critical time for the observed GSH effect on fibrosis. Increased alveolar macrophage (AM) numbers (lavage AM count 3.7X control at 7 days post exposure) may be involved in this effect. 4 references, 3 figures.

37976 (LMF—115, pp 313-318) **Distribution of microsomal monooxygenases in the rabbit respiratory tract.** Sabourin, P.J.; Dahl, A.R.; Tynes, R.E.; Philpot, R.M. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The distribution of the cytochrome P-450 isozymes and the FAD-containing monooxygenase in different anatomical regions of the rabbit respiratory tract was determined using immunoblot and enzymatic techniques. P-450 isozyme forms 2, 5, and 6 were found predominantly in the lung tissues although an appreciable amount of isozyme 5 was in maxilloturbinates also. Isozyme 4 was detected in ethmoturbinates and nasal epithelium but not in other respiratory tract tissues. This isozyme appeared to be responsible for the 7-ethoxyresorufin O-deethylase activity in these tissues. Enzymatic analysis indicates that an isozyme other than form 2 was probably responsible for benzphetamine N-demethylation in nasal tissues. Aniline hydroxylase activity, catalyzed by isozyme form 3a in liver, was highest in nasal tissues. The pulmonary form of the FAD-containing monooxygenase was detected in highest in amounts in the lung, but was also detected in other respiratory tract tissues. The qualitative and quantitative differences in monooxygenases in different regions of the respiratory tract may help explain site specific toxicity of chemicals. 6 references, 3 figures, 1 table.

37977 (LMF—115, pp 319-323) **Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs.** Bond, J.A.; Harkema, J.R.; Russell, V.I. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Some regions of the respiratory tract (RT) appear more susceptible to the tumorigenic action of inhaled chemicals than are others. Xenobiotic metabolizing enzymes in different regions of the Beagle dog's RT and epithelial cell populations associated with these different regions were characterized. Specific regions from one-half of the nasal (N), tracheal, bronchial, and pulmonary airways (PAs) were excised and analyzed for the presence of xenobiotic metabolizing enzymes. Complementary halves of airways were fixed and processed for light microscopy. Substrates for different isozymes of cytochrome P-450, including benzo(a)pyrene (BaP), nitropyrene (NP), benzphetamine, ethoxycoumarin and ethoxyresorufin were measured. There was a high rate of metabolism of BaP and NP in N tissues and in distal PAs. Less activity was observed in upper tracheobronchial (TB) airways. Most ethoxycoumarin o-deethylase activity was seen in N regions with little activity observed in TB or distal PAs. Only ethmoid turbinates showed evidence of ethyoxyresorufin metabolism. Epoxide hydrolase and glutathione transferase activity appeared evenly distributed along the RT. UDP-glucuronyl transferase activity appeared highest in N tissue and TB airways with less activity in distal PAs. All portions of sampled RT had unique epithelial populations ranging from squamous in proximal N, to olfactory in distal N, and ciliated epithelium in distal PAs. In conclusion, there is an uneven distribution of xenobiotic metabolizing enzymes and epithelial populations along dog RT. Clara cells were not evident in any of the airway epithelia examined. Therefore, other cell types (i.e., ciliated cells, goblet cells, nonciliated cuboidal cells and cells of the olfactory epithelium) are capable of metabolizing xenobiotics. 3 references, 3 figures.

37978 (LMF—115, pp 324-329) **Isolation and characterization of cytochrome P-450 isozymes from mouse liver.** Mitchell, C.E.; Ames, J.; Sabourin, P.J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The purpose of these studies was to determine the cytochrome P-450 isozymes responsible for nitroreductase and monooxidase activity in mouse liver that are induced by Aroclor 1254. Liver microsomes from mice treated with Aroclor 1254 were solubilized with sodium cholate and purified by chromatography on aminohexyl sepharose, DEAE-cellulose, and hydroxyapatite columns. Five cytochrome P-450 fractions (A1, A1, A3, B1, B2) were isolated and partially purified. Fraction B2 was the most active in arylhydrocarbon hydroxylase activity, fraction B1 in nitroreductase activity, and fraction A3 in benzphetamine N-demethylase activity. although these fractions the highest in the catalytic activities of specific substrates, some overlapping in substrate specificities was observed for some fractions. Further purification of P-450 fractions to near homogeneity is necessary to determine the absolute number of isozymes of P-450 and their characteristics in induced mouse liver, and subsequently, in uninduced mouse liver and lung and induced lung. 5 references, 3 figures.

37979 (LMF—115, pp 330-336) **Nasal metabolism of benzo[a]pyrene and dihydrosafrole in Beagle dogs and nonhuman primates.** Fischer, J.P.; Whaley, S.L.; Dahl, A.R. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

The purpose of this study was to determine the extent of nasal metabolism of $^{3}$H-dihydrosafrole and $^{14}$C-benzo[a]pyrene ($^{14}$C-BaP) by Beagle dogs and cynomolgus monkeys in two regions of the nasal cavity, the ethmoid (olfactory), and maxillary (respiratory) turbinates. Clearance of these two compounds from the nose was studied by collection of nasopharyngeal mucus, blood, urine, and feces during nasal instillation and up to 48 h afterwards. Analysis of the nasopharyngeal mucus showed that either turbinate region in both species metabolized $^{14}$C-Bap to dihydrodiols, quinones, phenols, and tetrols. $^{3}$H-Dihydrosafrole instilled in either turbinate region was extensively metabolized to 2-methyoxy-4-propylphenol. Other major metabolites were 2-methoxy-4-[2-propenyl]-phenol, and 3,4-methylenedioxy-1-(1-hydroxypropyl)benzene. The present study demonstrated a relatively noninvasive technique for studying regional nasal metabolic capabilities in xenobiotic in vivo. The results show that nasal cavities of dogs and monkeys are capable of metabolizing BaP into biologically significant compounds after instillation at both ethmoid and maxillary turbinates. 6 references, 4 tables.

37980 (LMF—115, pp 337-342) **Detection of DNA adducts formed from metabolites of 1-nitropyrene and 1-8-dinitropyrene in vitro.** Martin, O.S.; Mitchell, C.E.; Bond, J.A. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

DNA adducts were produced in vitro by the incubation of calf thymus DNA with 1-nitropyrene in the presence of xanthine oxidase under anaerobic conditions. Upon analysis by $^{32}$P-post-labeling techniques, it was found that 3 major and 3 minor DNA adducts were formed. One adduct was tentatively identified as N-(deoxyguanosin-8-yl)-1-aminopyrene, which has been observed previously in similar reactions, and comprised 51.5% of total radioactivity recovered as DNA adducts. The other five adducts have not yet been identified. The relative number of these 6 adducts formed in calf thymus DNA ranged from 70 adducts per $10^{6}$ normal nucleotides (for N-(deoxyguanosin-8-yl)- 1-aminopyrene) to 2.4 adducts per $10^{6}$ normal nucleotides. Attempts to produce DNA adducts from 1-nitropyrene or 1,8-dinitropyrene using rat liver microsomes instead of xanthine oxidase were not successful, presumably due to preferential binding of metabolites to microsomal proteins rather than calf thymus DNA. Thus, $^{32}$P-post-labeling techniques were successfully used to determine the number and relative binding of DNA adducts produced in vitro from metabolites of 1-nitropyrene. 8 references, 3 figures, 1 table.

37981 (LMF—115, pp 343-345) **Formation of DNA adducts in mouse tissues after 1-nitropyrene administration.** Mitchell, C.E. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

DNA adducts were isolated and characterized in mouse lung, liver and kidney after intratracheal instillation of [$^{3}$H]-1-nitropyrene (1-NP). HPLC analysis of the enzymatically digested DNA indicated the presence of multiple DNA adducts in mouse lung, liver and kidney. These results indicate that DNA adducts of 1-NP are formed in mouse lung, liver and kidney after intratracheal instillation of 1-NP; the HPLC profiles of the multiple adducts suggests that adducts may be formed via metabolic pathways that involve both nitroreduction and ring-oxidation. 6 references, 1 figure.

37982 (LMF—115, pp 350-352) **Effect of exogenous sources of cysteine on lung glutathione levels.** Kirkpatrick, D.T.; Newkirk, T.M.; Henderson, R.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

Tissue glutathione (GSH) is an important cellular protectant from toxic agents. Since exposure of the lung to toxic agents often takes place over extended periods of time and since post-exposure GSH levels have been shown to affect delayed pulmonary effects, it would be useful to induce elevations of lung GSH over extended periods. In the present study, injections with N-acetyl cysteine and oxothiazolidine-carboxylate, two agents which can be converted to cysteine intracellularly, were used in attempts to increase lung GSH. No increase in GSH was found after a 7-day (two 5 mmol/kg B.W. injections per day) treatment regimen with either agent. Ozone ($O_3$) exposure at 1 ppm (23 h/day) during the last 5 days of this treatment did not lead to effective GSH elevation by these agents. From these results, it appears that cysteine-supplying agents, given by serial injection, are not useful for elevation of lung GSH over extended time periods. 3 references, 2 tables.

37983 (LMF—115, pp 353-356) **Biochemical and cellular changes in nasal lavages after intranasal instillation of endotoxin.** Harmsen, A.G.; Harkema, J.R.; Hotchkiss, J.A.; Henderson, R.F. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

In order to study the inflammatory response in the nasal cavity and the role of neutrophils in that response, the authors instilled 500 μg of endotoxin into the nasal cavities of rats. The rats were killed immediately after instillation, or at 0.5, 1, 3, 6 or 24 h after instillation and the nasal cavities lavaged. A neutrophil response which peaked at 6 h was detected in the lavage fluids. The nasal exudate neutrophils had phagocytic ability and $H_2O_2$ production rates similar to those of peripheral blood neutrophils. At 6 h after endotoxin instillation, nasal lavage fluids contained elevated levels of leukotriene $B_4$, thromboxane $B_2$, prostaglandin $E_2$, β-glucuronidase, and alkaline phosphatase. These results suggest that neutrophils may be important in the defense of the nasal mucosal surface and that nasal lavage is a useful means of studying nasal mucosal inflammatory responses. 4 references, 2 figures, 2 tables.

37984 (LMF—115, pp 357-360) **Acute effects of neutrophils on nasal epithelial mucosubstances: quantitative histochemistry.** Harkema, J.R.; Harmsen, A.G.; Hotchkiss, J. Dec 1986. NTIS, PC A22/MF A01. File Number DE87009807.

In Inhalation Toxicology Research Institute: Annual report, October 1, 1985 through September 30, 1986.

F344/N rats were intranasally instilled with endotoxin to elicit a transient influx of neutrophils into the nasal respiratory epithelium. Peak intraepithelial infiltration of neutrophils was observed six h after instillation. A concomitant quantitative decrease in stored epithelial mucosubstance was also observed only at this time after instillation. Amounts of epithelial mucosubstance returned to preneutrophilic-infiltration quantities by 24 h after instillation, when intraepithelial neutrophils were diminishing. Rats depleted of peripheral blood neutrophils had a reduced neutrophilic response to the endotoxin and no concomitant change in the quantity of stored mucosubstance in the nasal epithelium as seen in nondepleted animals. Therefore, neutrophil influx could be responsible in part to the decrease in stored epithelial mucosubstance or hypersecretion often observed in acute airway inflammation. 2 figures.

37985 (NP—7770117) **Trace element analyses in order to determine heavy metal concentrations in lung tissues. A contribution to an objective assessment of occupational hazards.** Baumgardt, B. (Bochum Univ. (Germany, F.R.). Abt. fuer Chemie). 19 Feb 1985. 243p. (In German). NTIS (US Sales Only), PC A11. File Number DE87770117.

The dissertation provides a basis for routine AAS analysis of 10 different trace elements of environmental relevance in lung tissues. The analysis is able to detect Al, Be, Cd, Co, Cr, Cu, Fe, Mn, Ni, and Pb and thus helps doctors to distinguish between normal dust exposure and health hazards from dust exposure.

37986 (NP—7770118) **Effects of environmental factors (food, heavy metals) on teleostean hepatocytes.** Segner, H. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1985. 328p. (In German). NTIS (US Sales Only), PC A15/MF A01. File Number DE87770118.

The value of teleostean hepatocytes as environmental indicators was investigated by electron microscopy and atomic absorption spectroscopy for the factors 'food' and 'heavy metal contamination'. The cells of liver parenchyma responded to both factors. In case of heavy metal exposure, complex enrichment processes were ob-

served in the liver, depending on the nutritional condition of the animals. The cell reaction is different for different teleostean species; it is too unspecific as a rule to indicate the nature of the determining factor, and it provides information on the extent and intensity of the environmental effects. The latter point is decisive for the value of teleostean hepatocytes as environmental indicators. The findings can be utilized in applied research, e.g. in ecotoxicology and aquaculture. The value of a method based on cytological parameters was illustrated by the development of fish diets.

37987 **(NP—7770123) Uptake and distribution of heavy metals in annelidae, with particular regard to limnic tubificides (oligochaeta).** Back, H.G. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1985. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87770123.

The uptake and distribution of Pb, Cd, and Zn were investigated in Tubifex tubifex and Limnodrilus udekemianus (oligochaeta). Further, comparative laboratory and field experiments were made in marine vertebrates. The toxic heavy metals lead and cadmium were preferably taken up by respiratory epithels, e.g. the epidermis of the back end of the tubificides or the gills of Arenica marina (polychaeta). In Nereis diversicolor (polychaeta), the parapodia in which most of the gas exchange takes place were the preferred regions of metal uptake, both in laboratory and field experiments. In limnic tubificides, zinc inhibited the Cd uptake and promoted the Pb uptake. The AAS data and electron microscope data suggest three different uptake mechanisms for Pb (pinocytosis), Cd (facilitated diffusion), and Zn (uptake via an ATP-splitting process).

37988 **(OEFZS—4385) Products formed by photooxidants as factors for new types of forest decline. Results and considerations.** Grossmann, W.D. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Umweltplanung). Feb 1987. 27p. (In German). (NU—33/87). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.

Many of the important hypotheses on the new forest decline were checked in the systemic pilot-project Forest Rosalia ('Application of the method of maps over time in Austria'); most have low explanatory power in that research site. Only ozone will cause considerable, but not all damage. Other factors seem to exist which have not been explored until now. Evidence and calculations are supplied that these might be the aldehydes, organic acids, oxidants including peroxides and radicals. These pollutants act together (perhaps even synergistically) with the ozone in a way which might explain extent and form of the new forest decline in wide areas of Austria.

37989 **(OEFZS—4389) Bilateral information meeting Hungary-Austria, subject 'forest decline'.** Cabela, E. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Umweltplanung). Mar 1987. 151p. (In German). (NU—35/87; CONF-861291—). Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. .

From Bilateral information meeting Hungary-Austria on forest decline; Seibersdorf, Austria (1 Dec 1986).

The report includes 17 lectures by Hungarian and Austrian experts in the field of forest die-off ('Waldsterben').

37990 **(PB—87-137733/XAB) Summary review of the health effects associated with copper: health issue assessment.** Reisman, D.J.; Peirano, W.B.; Lewis, J.B.; Basu, D.K.; Hohrseiter, D. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Feb 1987. 87p. (EPA—600/8-87/001). NTIS, PC A05/MF A01.

The Health Assessment Summary Document is a brief review of the scientific knowledge on copper. The emphasis of the document is on inhalation exposure from atmospheric copper and the environmental, ecological, and health effects from the species of copper expected to be present in the atmosphere. The document is the scientific supporting basis for EPA decision-making concerning regulation of copper under the Clean Air Act. Specific scientific documentation on copper under the following headings is found in the document: Physical and Chemical Properties, Analytical Methods, Fate and Transport, Environmental and Exposure Levels, Pharmacokinetics, Toxicology and Human Health Effects. Ambient air exposure to copper adds little to the copper body burden for normal individuals. Human homeostatic mechanisms act to control copper balance in the body. Deficiencies or excesses of copper intake in humans rarely result in copper toxicosis. Special groups of risk include Wilson's disease individuals, children and some populations residing near production and processing facilities.

37991 **(PB—87-169488/XAB) Summarization of recent literature pertaining to an occupational health standard for cadmium. Final report.** (Syracuse Research Corp., NY (USA). Center for Chemical Hazard Assessment). Jun 1980. 102p. (SRC-TR—80-579). NTIS, PC A06/MF A01.

Available information on cadmium was reviewed. Topics discussed included human and animal toxicology, analytical and sampling methods, work practices, and engineering controls. Studies have shown that cadmium is absorbed by the body and distributed to various tissues with the lungs and gastrointestinal tract providing the primary routes of intake and adsorption. Industrial exposure arises mainly through inhalation of cadmium dusts and fumes. Cigarette smoking significantly increases exposure to cadmium through this route. Fumes and dusts produce acute and chronic lung disease and chronic systemic disease. Occupational exposure to cadmium is frequently involved simultaneous with exposure to other metals, complicating the problem of isolating a single causative agent. The kidney is the critical organ for long term effects. The liver is considered to be one of the primary sites of cadmium accumulation and a major site of detoxification. Evidence for cadmium induced hypertension is still unclear. There is little human data concerning the transfer of cadmium across the placenta, uptake and distribution of cadmium in the embryo and fetus, and teratogenic effects. Available data fail to provide conclusive evidence that cadmium causes cancer.

37992 **(PB—87-171682/XAB) Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the rtecs computer tape. Annual edition.** Sweet, D.V. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 119p. NTIS, PC A06/MF A01.

For system on magnetic tape available as a subscription, see PB—87-900300. Supersedes PB—86-170800.

The 1986 edition of the Registry of Toxic Effects of Chemical Substances (RTECS), formerly known as the Toxic Substances List, is the fifteenth annual revision prepared in compliance with the requirements of Section 20(a)(6) of the Occupational Safety and Health Act of 1970 (Public Law 91-596). The original list was completed on June 28, 1971, and has been updated annually in book format. Beginning in 1977, computer tapes of the complete RTECS file have also been provided. In 1986, these tapes were provided quarterly, in January, April, July, and October. The 1986 edition of the RTECS computer tape, which was issued in January 1987, contains 86,969 substance entries and supersedes all previous RTECS tape editions. A complete description of the various types of data in the RTECS file is contained in the Detailed File Description. The user is strongly encouraged to read this material before processing the data, since the data should not be used until the limitations of the RTECS file regarding data validity, completeness, and applicability are understood.

37993 **(PB—87-175063/XAB) Species comparison of acute inhalation toxicity of ozone and phosgene.** Hatch, G.E.; Slade, R.; Stead, A.G.; Graham, J.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 13p. (EPA—600/J-86/288). NTIS, PC A02/MF A01.

Pub. in Jnl. of Toxicology and Environmental Health, Vol. 19, 43-53(1986).

A comparison of the concentration-response effects of inhaled ozone ($O_3$) in different species of laboratory animals was made in order to better understand the influence of the choice of species in inhalation studies of this gas. The effect of 4-hour exposure to ozone ($O_3$) at concentrations of 0.0, 0.2, 0.5, 1.0, and 2.0 ppm was determined in rabbits, guinea pigs, rats, hamsters and mice. Lavage fluid protein (LFP) accumulation 18 hr after exposure was used as the indicator of $O_3$-induced pulmonary edema. All

species had similar basal levels of LFP (250-350 ug/ml) when a volume of saline which approximated the total lung capacity was used for lavage of the collapsed lungs. Exponential dose-response curves were seen in all species except guinea pigs, which showed significant increases in LFP at low $O_3$ concentrations (0.2 ppm) and a leveling off of response at the higher $O_3$ levels. Other species usually showed significant elevations in LFP only at concentrations greater than 0.5 ppm. Recovery of lavage fluid as a percent of the amount of injected saline varied significantly between species, and between $O_3$ concentrations; higher $O_3$ levels causing lower recovery. The time course of LFP accumulation also appeared to vary according to the species.

37994 **(PB—87-175600/XAB) Airway sensitivity of asthmatics to sulfur dioxide.** Horstman, D.; Roger, L.J.; Kehrl, H.; Hazucha, M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 12p. (EPA—600/J-86/282). NTIS, PC A02/MF A01.

Pub. in J. of Toxicology and Industrial Health, Vol. 2, No. 3, 289-298(1986).

Airways' sensitivity to $SO_2$, ($PC(SO_2)$), was defined as the concentration of $SO_2$ which provoked a 100% increase in specific airways' resistance (SRaw). $PC(SO_2)$ was determined for 2. asthmatics performing moderate exercise while exposed to several concentrations of $SO_2$ up to 2.0 ppm. Substantial variability in sensitivity was observed: for 20% of the subjects, $PC(SO_2)$ was greater than 1.95 ppm $SO_2$, while for the remaining 80%, it ranged between 0.28 and 1.38 ppm $SO_2$. The median $PC(SO_2)$ was 0.75 ppm $SO_2$. $PC(SO_2)$ and nonspecific airways' sensitivity to methacholine were not related.

37995 **(PB—87-175782/XAB) Cadmium technical support document.** (Environmental Protection Agency, Washington, DC (USA). Office of Pesticide Programs). Sep 1986. 90p. (EPA—540/09-077). NTIS, PC A05/MF A01.

This Position Document addresses the risks and benefits of pesticide products containing the subject active ingredient. The Agency has determined that the use of products containing the subject active ingredient may meet or exceed a risk criterion described in 40 CFR Part 154. Potential hazards will be examined further to determine the nature and extent of the risk, and considering the benefits of the subject active ingredient, whether such risks cause unreasonable adverse effects on the environment.

37996 **(PB—87-175824/XAB) Interspecies dosimetry of reactive gases.** Miller, F.J.; Overton, J.H.; Gerrity, T.R.; Graham, R.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Mar 1987. 36p. (EPA—600/D-87/105). NTIS, PC A03/MF A01.

The development of dosimetry models that can provide a description of the uptake and distribution of inhaled compounds throughout the body and the availability of animal toxicological data are integral components for a full evaluation of potential risks associated with human exposure. Interspecies dosimetric comparisons must be approached using a model conceptualization that incorporates the major factors affecting the uptake of the gas, such as respiratory tract morphology, route of breathing, depth and rate of breathing, physicochemical properties of the gas, etc. Modeling efforts thus far have primarily focused on ozone. A comparison of theoretical predictions of delivered dose of ozone to the lower respiratory tract of man shows good agreement with dose estimates derived from experimental measurements. Applications to ozone toxicological data in animals and man have been examined that incorporate the use of dosimetry models in studying quantitative dose-response relationships.

37997 **(PB—87-175949/XAB) Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version).** Spehar, R.L.; Fiandt, J.T. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1986. 17p. (EPA—600/J-86/297). NTIS, PC A02/MF A01.

Pub. in Environmental Toxicology and Chemistry, Vol. 5, 917-931(1986); See also PB—86-122579.

Acute and chronic toxicity tests were conducted with three aquatic species to determine the effects of metals combined as mixtures at proposed water quality criteria concentrations and at multiples of the LC50 and maximum acceptable toxicant concentration (MATC) obtained from tests on six metals. These studies were the first part of a larger research effort to derive water-quality criteria for combined pollutants by the U.S. Environmental Protection Agency.

37998 **(PB—87-179115/XAB) Mercury hazards to fish, wildlife, and invertebrates: a synoptic review.** Eisler, R. (Patuxent Wildlife Research Center, Laurel, MD (USA)). Apr 1987. 102p. (BIOLOGICAL—85(1.10)). NTIS, PC A06/MF A01.

Most authorities agree on six points: (1) Mercury (Hg) and its compounds have no known biological function, their presence in the cells of living organisms is undesirable and potentially hazardous; (2) Forms of Hg with relatively low toxicity can be transformed into forms of very high toxicity, such as methlymercury, through biological and other processes; (3) Hg can be bioconcentrated and biomagnified through food chains; (4) Hg is a mutagen, teratogen, and carcinogen; (5) Some species of fish and wildlife contain normally elevated levels of Hg, not attributable to man's activities. The significance of elevated Hg levels in animal tissues is not fully understood. Usually, however, concentrations in excess of 1100 Hg/kg fresh weight in kidney, brain, blood, hair, or liver should be considered as presumptive evidence of environmental Hg pollution.

37999 **(PB—87-181137/XAB) Effects of acid precipitation on plant diseases.** Bruck, R.I.; Shafer, S.R. (North Carolina State Univ., Raleigh (USA). Dept. of Plant Pathology). 1984. 17p. NTIS, PC A02/MF A01.

Pub. in Direct and Indirect Effects of Acidic Deposition on Vegetation, Acid Precipitation Series, 5, 19-32(1984).

Most plant diseases consist of delicate interactions between higher plants and microorganisms. Acidic precipitation represents an environmental stress that has been shown to affect expected development of some diseases and similar phenomena under experimental conditions. From the perspective of the disease triangle framework, this impact may be expressed through increased plant susceptibility, decreased plant susceptibility through altered metabolic pathways, decreased pathogen activity or increased pathogenicity. Aerial plant parts are directly exposed to rainfall and the potential influence of acidic precipitation on pathogen and diseases of above ground tissues seems obvious. However, soilborne pathogens and root diseases may also be significantly altered by short-term acidification of the soil solution resulting from acid deposition, or by gradual changes in bulk soil chemical characteristics over a long period of time.

38000 **(PB—87-182101/XAB) Effects of contaminants on naiad mollusks (Unionidae): a review.** Havlik, M.E.; Marking, L.L. (Fish and Wildlife Service, Washington, DC (USA)). 1987. 27p. (RESOURCE PUB—164). NTIS, PC A03/MF A01.

Although the uptake, storage, and elimination of contaminants by naiad mollusks has been studied, relatively little information is available on toxicity. Contaminants appear to have destroyed some population directly by exerting toxic effects, or indirectly by causing or contributing to the elimination of essential food organisms or host fish. The most-frequently studied contaminants are Cd, Cu, Mn-Mn54, Pb-Pb210, Zn-Zn65. Manganese seems to be most readily taken up and stored in tissues; no apparent damage has been reported from tissue concentrations of thousands of parts per million (ppm), and the element appears to be essential to metabolism. Zinc and cadmium also accumulate at high levels in tissues. Lead was never found to be lethal in the studies reviewed. Various common contaminants have been reported to be toxic at the following concentrations (ppm): cadmion, 2; copper sulfate, 2 to 18.7; ammonia, 5; potassium, 11; chromium, 12.4; arsenic trioxide, 16; copper, 19; and zinc, 66. In long-term exposures, concentrations of copper as low as 25 parts per billion (ppb) were lethal.

38001 **(PB—87-182697/XAB) Modeling ozone absorption in the lower respiratory tract.** Overton, J.H.; Miller, F.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Apr 1987. 19p. (EPA—600/D-87/129). NTIS, PC A02/MF A01.

A dosimetry simulation model was developed for predicting the local absorption of ozone in the lower respiratory tract (LRT) of animals and man. The model takes into account species LRT anatomy and ventilatory characteristics, transport in the lumen and air spaces, loss of $O_3$ to the liquid lining, and transport and chemical reactions in the liquid lining and underlying tissues and capillaries. Basic biological concepts and the mathematical formulation of the model are briefly outlined and the results of several investigations presented. Predicted values of LRT uptake are compared to experimental $O_3$ uptake data in humans, showing good agreement over the range of experimental tidal volumes and breathing frequencies. The effect of airway path distance on centriacinar ozone dose is explored; large variations in dose for the first alveolated ducts in a rat are predicted. Human and rat generational doses versus generation are plotted together for comparison; the curves demonstrate a remarkable similarity with regards to shape and structure.

38002 **(PB—87-186151/XAB) Evaluation of the carcinogenicity of unleaded gasoline.** (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Apr 1987. 403p. (EPA—600/6-87/001). NTIS, PC A18/MF A01.

In the document the likelihood that unleaded-gasoline vapors are carcinogenic to humans is evaluated. From carcinogenicity data in animals, an estimate is made of the magnitude of cancer risk a person would experience, under the assumption that gasoline vapors are carcinogenic. All biological factors believed to be relevant to carcinogenesis are reviewed. A quantitative analysis of cancer incidence in the two long-term animal gasoline-inhalation studies is performed, an upper-bound cancer risk potency estimate is calculated, and the uncertainties in the estimate are discussed. The major conclusions are: (1) although employment in the petroleum refineries is possibly associated with cancers of the stomach, respiratory system, and lymphopoietic and hematopoietic tissues, exposure to gasoline cannot be implicated as a causative agent because of confounding exposure to other chemicals and inadequate information on gasoline exposure; (2) the occurrence of liver cancer in female mice and kidney cancer in male rats provides sufficient evidence in animals that inhalation of wholly aerosolized gasoline is carcinogenic; and (3) gasoline vapors from vehicle refueling might be less carcinogenic than indicated by animal experiments using wholly aerosolized gasoline, if the less volatile components, which are apparently responsible for acute kidney toxicity, also contribute to the observed carcinogenic response.

38003 **(PB—87-187134/XAB) Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment.** Lewtas, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1985. 15p. (EPA—600/D-85/273). NTIS, PC A02/MF A01.

Pub. in Short-Term Bioassays in the Analysis of Complex Environmental Mixtures IV, 363-375(1985).

The primary problem regarding the introduction of new energy sources is whether they will alter the mutagenicity, carcinogenicity, and potential human cancer risk from combustion emissions. New risk assessment methodologies utilizing data from short-term bioassays, therefore, are needed to assess new technologies as they are being developed. This will allow the development of alternative combustion and control methods that lower human risk. In order to assess the relative human cancer risk associated with introducing diesel-powered automobiles as an alternative fuel-efficient energy source for transportation, the authors have developed a comparative data base and risk-assessment methodology. This risk-assessment model and methodology is applicable to the evaluation of various complex mixtures. The paper describes a comparative approach to evaluating alternative energy sources by utilizing short-term genetic bioassays.

38004 **(PB—87-188132/XAB) Pulmonary antioxidants.** Massaro, E.J.; Grose, E.C.; Hatch, G.E.; Slade, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). May 1987. 52p. (EPA—600/D-87/143). NTIS, PC A04/MF A01.

One of the most vital of the cellular defenses against pollution is an antioxidant armanentarium which consists of oxidant scavenging molecules such as vitamin E, glutathione, vitamin C, and uric acid as well as a number of enzymes (superoxide dismutase, semidehydroascorbate reductase, catalase, GSH synthetase, GSH peroxidase, GSH reductase, and GSH transferase) and appears to function in keeping oxidant forces under control. Pollutants can upset the oxidant/antioxidant balance of cells by inhibiting vital enzymes, by reacting with oxidant scavengers, or by forming free radical intermediates which initiate uncontrolled tissue reactions with molecular oxygen. The book chapter reviews possible interactions between pollutants and the oxidant/antioxidant balance.

38005 **(PB—87-900300/XAB) Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files.** Sweet, D.V.; Fang, J.; Shiang, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1986. mag tap. NTISSubscription.

Supersedes PB—86-165768; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—87-171682. Available on subscription, North American Continent price $2000.00/year; all others write for quote. Issued quarterly.

These tapes contain the data and bibliographic CODEN files of the 1986 Registry of Toxic Effects of Chemical Substances (RTECS). Formerly known as the Toxic Substances List, the Registry is an annual compendium of toxicity data abstracted from the scientific literature by the National Institute for Occupational Safety and Health (NIOSH) in compliance with the Occupational Safety and Health Act of 1970. The 1986 RTECS file contains 310,300 entries; 86,969 are names of unique chemicals with their associated toxicity data and 223,331 entries are synonymous names. For each compound, the following data are provided: prime name and synonyms, CAS number, molecular weights and formulas, date when substance record was last updated, Wiswesser Line Notations irritation, mutation, reproductive effects, tumorigenic, and toxic dose data with references; toxicology reviews; carcinogenic assessments; government standards and regulations; ACGIH-Threshold Limit Values; NIOSH Recommended Exposure Limits; Current Intelligence Bulletins and Analytical Methods; NTP bioassay results; and EPA status. The Registry provides information on known toxic and biological effects of chemical substances for use by employers, employees, physicians, industrial hygienists, toxicologists, researchers, and others concerned with the safe handling of chemicals. The absence of a substance from the Registry does not indicate that it is not toxic. The toxic doses presented are not to be considered definitive doses for describing safe versus toxic doses for human exposure.

38006 **(PNL—5979) Analysis of medium-BTU gasification condensates, June 1985-June 1986.** Elliott, D.C. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011107.

This report provides the final results of chemical and physical analysis of condensates from biomass gasification systems which are part of the US Department of Energy Biomass Thermochemical Conversion Program. The work described in detail in this report involves extensive analysis of condensates from four medium-BTU gasifiers. The analyses include elemental analysis, ash, moisture, heating value, density, specific chemical analysis, ash, moisture, heating value, density, specific chemical analysis (gas chromatography/mass spectrometry, infrared spectrophotometry, Carbon-13 nuclear magnetic resonance spectrometry) and Ames Assay. This work was an extension of a broader study earlier completed of the condensates of all the gasifers and pyrolyzers in the Biomass Thermochemical Conversion Program. The analytical data demonstrates the wide range of chemical composition of the organics recoverd in the condensates and suggests a direct relationship

between operating temperature and chemical composition of the condensates. A continuous pathway of thermal degradation of the tar components as a function of temperature is proposed. Variations in the chemical composition of the organic in the tars are reflected in the physical properties of tars and phase stability in relation to water in the condensate. The biological activity appears to be limited to the tars produced at high temperatures as a result of formation of polycyclic aromatic hydrocarbons in high concentrations. Future studies of the time/temperature relationship to tar composition and the effect of processing atmosphere should be undertaken. Further processing of the condensates either as wastewater treatment or upgrading of the organics to useful products is also recommended. 15 refs., 4 figs., 4 tabs.

38007 **(UCRL—96644) Molecular approaches to the detection of germinal mutations in mammalian organisms, including man.** Mohrenweiser, H.W.; Branscomb, E.W. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 13p. (CONF-8703142—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010871.

From New trends in genetic risk assessment meeting; Nice, France (9 Mar 1987).

The need for estimates of human germinal mutation rates arises from the need to define the mutation rate, the associated health burden, and the spectrum of "spontaneous" germinal mutational lesions in unexposed subjects, and the need to monitor the suspected increase in mutation rate in populations exposed to known or suspected genotoxic agents. It must be possible to analyze, in a meaningful manner, the frequency and spectrum of mutational events in relatively small populations. Therefore, it is critical that a large portion of the genome in each proband is screened, otherwise, given the anticipated limitation on the number of individuals in the study population, it will not be possible to obtain a statistically significant data base. It is also important that the method(s) detect the spectrum of molecular lesions, so that significant increases in the mutation rate are not missed because a class of mutational event was not identified. Since most of the human risk estimates will be derived from data generated in model systems and test animals, rather than from data derived from studies of human populations, the data bases generated in human studies must serve as reference points for extrapolation from test systems. 45 refs.

38008 **Anaerobic catabolism of formate to acetate and $CO_2$ by Butyribacterium methylotrophicum.** Kerby, R.; Zeikus, J.G. (Upjohn Co., Kalamazoo, MI). *Journal of Bacteriology;* **169**: No. 5, 2063-2068(May 1987). Contract FG02-85ER13376.

The catabolism of sodium formate to acetate and carbon dioxide by the anaerobic acetogen Butyribacterium methylotrophicum was analyzed by fermentation time course and $^{13}C$ nuclear magnetic resonance studies. Significant hydrogen production and consumption fluxes were observed during formate catabolism but not during the catabolism of formate plus CO. In the latter case, formate and CO were simultaneously consumed and label distribution studies with mixtures of $^{13}C$-labeled CO and formate demonstrated their preferential incorporation into the acetate carboxyl and methyl groups, respectively. Hydrogen consumption was inhibited by CO when both were present, whereas hydrogen and formate were simultaneously consumed when $CO_2$ was supplied. Carbon dioxide was required for the conversion of CO to acetate, but a similar need was not observed when methanol plus CO or formate plus CO was present. These analyses indicate a bifurcated single-carbon catabolic pathway in which $CO_2$ is the sole single-carbon compound that directly supplies the carbonyl and methyl group synthesis pathways leading to the formation of acetyl coenzyme A, the primary reduced product. The authors discuss causes for the reported inability of B. methylotrophicum to use formate as a sole substrate.

38009 **Metabolism of gallate and phloroglucinol in Eubacterium oxidoreducens via 3-hydroxyl-5-oxohexanoate.** Krumholz, L.R.; Crawford, R.L.; Hemling, M.E.; Bryant, M.P. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **169**: No. 5, 1886-1890(May 1987). Contract AC02-81ER10874.

The pathway for anaerobic catabolism of gallic acid by Eubacterium oxidoreducans was studied by using both in vivo and cell-free systems. Cells grown with gallate and crotonate, but with no formate or $H_2$, excreted pyrogallol and phloroglucinol into the medium. Gallate was decarboxylated by crude cell extracts, with pyrogallol as the only detectable product. Whole cells converted pyrogallol to phloroglucinol. A phloroglucinol reductase catalyzed the conversion of phloroglucinol to dihydrophloroglucinol when NADPH was used as the source of electrons. Both formate dehydrogenase and hydrogenase were present in cell extracts of gallate-formate-grown cells. These two enzymes were both NADP linked. Since either $H_2$ or formate is required for cell growth with gallate or phloroglucinol, these results suggest that the oxidation of the reduced substrate may be indirectly linked to the reduction of phloroglucinol. A dihydrophloroglucinol hydrolase was present, which hydrolyzed dihydrophloroglucinol to 3-hydroxy-5-oxohexanoate. This six-carbon ring cleavage product then presumably can be broken down by a series of reactions similar to $\beta$-oxidation. These reactions cleaved the six-carbon acid to 3-hydroxybutyryl-coenzyme A yielding acetate and butyrate as end products. A number of key enzymes involved in $\beta$-oxidation and substrate-level phosphorylation were demonstrated in cell extracts.

38010 **Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide.** Yoshida, H.; Swenberg, C.E.; Geacintov, N.E. (Armed Forces Radiobiology Research Institute, Bethesda, MD). *Biochemistry;* **26**: No. 5, 1351-1358(10 Mar 1987). Contract FG02-86ER60405;AC02-78EV04959.

The dynamic conformational changes due to the noncovalent intercalative binding of ethidium bromide and racemic trans-7,8-dihydroxy-anti-9,10-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene (BPDE), and the covalent binding of BPDE to supercoiled phi X174 DNA, have been studied by gel electrophoresis and a novel application of a kinetic flow linear dichroism technique. The magnitude of the linear dichroism of the DNA oriented in the flow gradient is sensitive to the hydrodynamic shape of the DNA molecule which is affected by the binding of the drug or the carcinogen BPDE. The kinetic flow dichroism spectra indicate that the noncovalent BPDE-DNA complexes are intercalative in nature, while the covalent adducts are characterized by a very different conformation in which the long axes of the pyrenyl residues are oriented at a large angle with respect to the average orientation of the planes of the DNA bases. These results suggest that conformations of carcinogen-DNA adducts, other than intercalative ones, can cause the unwinding of superhelical DNA. The flow dichroism method is capable of following kinetically changes not only in the shapes, and thus conformations of supercoiled DNA molecules, but also in the conformations of drugs or carcinogens causing these changes.

## 5604 Other Environmental Pollutant Effects

*REFER ALSO TO CITATION(S) 36738*

38011 **(AD-A—179220/9/XAB) Laser Hazards Bibliography (12th Edition).** Sliney, D.H.; Galoff, P.K.; Robinson, A.; Rush, J. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). 31 Oct 1986. 220p. NTIS, PC A10/MF A01.

The Laser Hazards Bibliography consists of 2979 references in the open literature broken into subject categories which relate to general biological effects, the eye, the skin, laser safety, laser propagation in the atmosphere, and laser measurements.

38012 **(AD-A—179275/3/XAB) Metabolic effects of microwave radiation and convection heating on human mononuclear leukocytes. Final report, January 1985-May 1986.** Kiel, J.L.; Wong, L.S.; Erwin, D.N. (School of Aerospace Medicine, Brooks AFB, TX (USA)). 1986. 9p. (USAFSAM-JA—86-43). NTIS, PC A02/MF A01.

Pub. in Physiological Chemistry and Physics and Medical NMR, Vol. 18, 181-187(1986).

Investigated here were the effects of microwave (MW) radiation (2450-MHz, continuous-wave, mean specific absorption rate of 103.5 + or - 4.2 W/kg) and convention heating on the nonphosphorylating oxidative metabolism of human peripheral mononuclear

leukocytes (96% lymphocytes, 4% monocytes) at 37 C. Metabolic activity, determined by chemiluminescence (CL) of cells challenged with luminol (5-aminO-2, 3-dihydro-1, 4-phthalazinedione) linked to bovine serum albumin, was detected with a brightness photomer. A significant stimulation after after MW exposure ($p < 0.005$) over total CL of matched 37 C-incubator controls was observed. A similar degree of stimulation, compared to incubator controls, was also detected after sham treatment. No significant difference existed between changes in total CL or stimulation indices of the MW and sham-exposed groups. Exposure to MW radiation, under normothermic (37 + or - 0.03 C) conditions, appears to have no effect on the oxidative metabolic activity of human peripheral mononuclear leukocytes. However, the significant differences between MW or sham-exposed cells and their respective incubator controls occurred because the temperature of the incubator did not exceed 35.9 C, and 39 minutes were required for the temperature to rise from 22 to 35.9 C. Slow heating of incubator controls must be accounted for in thermal and redio-frequency radiation studies in vitro.

38013 **(AD-A—180111/7/XAB) Evaluation of drugs for prevention of hyperthermia in rats exposed to microwave irradiation. Final report, 1983-1985.** Knepton, J.; Cobb, B. (Naval Aerospace Medical Research Lab., Pensacola, FL (USA)). 4 Mar 1987. 17p. (NAMRL—1328). NTIS, PC A02/MF A01.

The objective of this study was to determine the effectiveness of two antipyretic drugs, indomethacin and dihydrotachysterol, in the prevention of microwave-induced hyperthermia in rats. Indomethacin has been proven effective in reducing fever of pyrogenic origin. Dihydrotachysterol (DHT) is effective in increasing survival of rats during heat stress. After being acclimated to restraint in an acrylic cone-shaped holder and to the presence of a colonic temperature probe each rat was subjected to a series of body-temperature measurements under various drug and microwave conditions. Pretreatment with both drugs consisted of single and multiple injections prior to microwave exposure. Multiple does of DHT caused a progressive fall in baseline body temperature, but did not affect the relative increase in temperatures due to microwave irradiation. Single-injection procedures did not reduce temperature elevation due to microwave irradiation. Neither indomethacin nor DHT were found to ameliorate microwave-induced hyperthermia.

38014 **(NP—7770114) Study investigating the impact of aircraft noise on physiological, endocrinological and ethological criteria with regard to pregnant sows, roaming free or kept in barns.** Schriever, K. (Tieraerztliche Hochschule Hannover (Germany, F.R.)). 20 Jun 1985. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770114.

Twenty-one sows in different stages of pregnancy were subjected to stress induced by 123 overflight events of airplanes on 9 days altogether (3 x 3 days). Ten of the sows were roaming free in the pasture and 11 of them were kept in single ranging in a closed barn. The following observations were registered in order to answer the question whether aircraft, flying at low altitudes do provoke reactions which will lead to adaption or to exhaustion of the adrenal cortex and whether reproduction is affected: noise pressure level, slope, duration and frequency pattern of the noise of the aircraft; altitude and speed of the different aircraft during the overflight events; concentration of plasma estrogens and progesterone overall plasma corticoids; video recordings and notes to evaluate the behaviour of the animals. The results permit the following statements: The general behaviour of the sows was not affected over a long range; the kind and intensity of the reaction does not only depend on acoustical but also on optical and tactile impressions as well as on the degree of adaption; there are indications of an adaption to the overflight events which could be observed within the series of overflights as well as from day to day; there were no injuries or accidents in connection with the overflights which could have caused abortions; rises in plasma corticoid levels which were directly related to the overflights hint towards a severe strain on the animals; an influence on the plasma estrogens and progesterone concentrations could not be observed and all data recorded showed differences in the individual reaction of the animals.

38015 **(LA-tr—87-13) Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field.** Vassout, P.; Franke, R.; Parmentier, G.; Evrard, G.; Dancer, A. (Los Alamos National Lab., NM (USA); Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 1987. Contract W-7405-ENG-36. Translation of ISL-R—112/86. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011135.

A theoretical study on the propagation of a pressure wave in a diphasic medium, when compared to the onset mechanism of pulmonary lesions in subjects exposed to strong shock waves, shows an increase in the incident overpressure at the interface level. Using hydrophones, intracorporal pressure was measured in pigs. The authors recorded the costal wall acceleration on the side directly exposed to the shock wave and calculated the displacement of the costal wall after a shock wave passed by. These experiments were conducted for shock waves in a free field, at an overpressure peak level ranging from 26 kFPa to 380 kPa and for a first positive phase lasting 2 ms. Sensors placed in an intracorporal position detected no increase of the overpressure level for any value of the incident pressure. A comparison of the costal wall displacement, measured experimentally, relative to the theoretical displacement of the entire animal mass indicates that the largest relative displacement of the costal wall could be the origin of the pulmonary lesions found. 5 refs., 13 figs.

# 57 HEALTH AND SAFETY

38016 **(PNL-SA—14976) The application of expert systems to the analysis of logic trees.** Franklin, A.L. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 13p. (CONF-870657—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011994.

From Personal computer applications in the gas industry; Chicago, IL, USA (22 Jun 1987).

Fault trees are a subject of logic trees. An application developed for the US Bureau of Mines uses artificial intelligence techniques to improve the availability of information contained in logic tree representations. FALTS (Failure Analysis and Logic Tree System) is a generalized knowledge-based system package designed to organize, identify, and communicate logic tree information. FALTS has been developed to provide a forum for investigating and preserving information describing the interdependencies of system components and subcomponents. The basic premise behind FALTS is that the representation and analysis of component dependencies can be standardized while specific dependency information can vary from system to system. The processing abilities of FALTS gives it the appearance of a logic tree analyst expert. Given a sufficient system description, FALTS is capable of identifying the logical pathways leading to a particular event, the base events involved in any particular pathway, and the sequence of event that would result from the occurrence of a particular combination of base events. It is intended that FALTS be used as a predictive system for interfacing mine safety officials with the status and potential circumstances of mine operations. However, FALTS has been generalized to be used outside the mining industry.

38017 **(UCRL—95561) Pressure safety training for a large research and development facility.** Kotowski, M.J. (Lawrence Livermore National Lab., CA (USA)). 19 May 1987. Contract W-7405-ENG-48. 16p. (CONF-8709106—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009850.

From Conference on safety in handling glass; Annecy, France (16 Sep 1987).

The LLNL pressure safety program works. We have very few mishaps, and there has been only one injury accident in recent years. In that case, our pressure safety program had been ignored. We believe that it is the most comprehensive and successful program of its kind in the US. The LLNL pressure safety program is successful because it is comprehensive and addresses the needs of all our employees who work with pressure. Pressure safety training is the element that makes the program work and assures almost complete cooperation by all employees. This enables us to continue our work with hazardous materials under pressure.

# 58 GEOSCIENCES

38018 (AD-A—179430/4/XAB) **Medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide at 800k.** Barowy, W.M.; Esplin, M.P.; Vanasse, G.A.; Huppi, R.J. (Utah State Univ., Bedford, MA (USA). Stewart Radiance Lab.). 8 Jan 1987. 63p. (SCIENTIFIC—21). NTIS, PC A04/MF A01.

A high resolution interferometer was used to measure the medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide heated to 800K. Modifications were made to the instrument to improve its wavelength accuracy and reliability. In the 4.3-micrometer region, 5 bands of (12)C(16)O(18)O were identified and the corresponding spectral constants were reduced. The constants reproduce the position of the spectra lines to within 0.0005/cm. Absorption spectra of $N_2O$ and $CO_2$ in the 7.8 and 15-micrometer regions, respectively, were recorded and their preliminary analysis has been completed.

## 5801 Geology And Hydrology

*REFER ALSO TO CITATION(S) 36509, 37454, 37604, 38070*

38019 (CONF-8608141—, pp 119-129) **Influence of site disturbance on $\delta^{13}C$ isotopic time series from tree rings.** Leavitt, S.W.; Long, A. (Univ. of Wisconsin, Parkside). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

In this study, the authors examined three types of disturbances which, in principal, could influence $\delta^{13}C$ of trees through their effect on light levels, nutrients and plant health. These disturbances include forest fire and selective cutting events at the Thomas Creek watershed in Arizona, and spruce budworm defoliation at the Capulin site in New Mexico. The results give some evidence of elevated $\delta^{13}C$ values in trees affected by defoliation and deforestation. However, even if real, the isotopic deviations are subtle rather than large, distinctive and disturbance-specific. Thus, influence of these types of site disturbances on long tree-ring time series may well be minor, and therefore ecologic reconstructions from these time series would be difficult. 10 references, 4 figures.

38020 (CONF-8608141—, pp 213-223) **Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis.** Alexander, V.; McCord, S. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Rates of slope degradation can be estimated from the age and depth of exposure of the roots of long-lived trees. Rates of aggradation can be estimated from depth of burial and the time since death of trees buried by alluvium. Dead Juniper Wash, a tributary of Dinnebito Wash on Black Mesa, Arizona, provides an opportunity to make a detailed reconstruction of Holocene erosion rates and sediment transport and storage history. Many of the pinyon and juniper trees growing on the hillslopes of this drainage basin have their roots exposed to various depths by erosion of the underlying Cretaceous sandstone and siltstone (Wepo Fm). The drainage bottoms are filled with several meters of Holocene sediments containing abundant buried juniper trees with germination dates extending back to before 1400 AD. In the lower reaches the buried trees are being exhumed by arroyo cutting, but in the upper reaches and near the sides living trees are currently being buried by alluvium derived from the hillslopes. Death dates range from the 1500's and 1600's in the center of the basin up to the present near the edges of the sedimentary body. Analysis of tree-ring materials from this site indicates an average erosion rate of 0.33mm/yr over the last 650 years, a total sediment yield of about $10^6$ $m^3$ during this time, and that about half of this sediment has been stored in the sedimentary body in the drainage bottom. 23 references, 8 figures.

38021 (CONF-8608141—, pp 261-271) **Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana.** Conner, W.H.; Mueller, R.A. (Louisiana State Univ., Baton Rouge). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

It is commonly stated in the scientific literature that ideal conditions for baldcypress regeneration occur on the order of every 30 to 50 years during extreme dry years, and this results in baldcypress stands being made up of even-aged groups of trees. However, no one has ever undertaken to determine the age structure of a stand of baldcypress tress and look at the historical climate record to determine if the trees did become established at the time most suited for their survival- a drought of one to two growing seasons. In this study, tree slabs were taken from 50 small baldcypress saplings and tree cores from 35 large trees to determine if it was possible to group trees into age classes. A computerized water budget program was used to compare the hydrologic variables since 1871 with the physioecology of baldcypress. Indications are that this technique may be an excellent means of correlating age of the stand of trees with drought conditions predicted by the water budget. 32 references, 5 figures.

38022 (CONF-8608141—, pp 272-280) **Annual rings of trees from Central Amazonian inundation forests.** Worbes, M.; Leuschner, H. (Max-Planck-Institut fuer Limnologie, Ploen, West Germany). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The periodical growth zones of trees from Central Amazonian inundation forests represent annual rings. Combined investigations of wood anatomy, tree-ring analyses and radiocarbon dating allow the age of tropical trees to be determined and show in the present case connections between the growth rhythm of trees and the duration of annual flooding. Defoliation behavior of Varzea trees and results of wood anatomy investigations indicate that cambial dormancy is an adaptive strategy to periodical floodings. 21 references, 7 figures.

38023 (CONF-8608141—, pp 290) **Dating landslides in Hudson Bay area, Quebec.** Begin, C.; Filion, L. (Universite Laval, Sainte-Foy, Quebec). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A 12-km long terrace along the estuary of the Grande riviere de la Baleine (55°-17'N, 77°47'W) has been locally modified by seven large landslides during the last 3200 $^{14}C$-yr BP. The three oldest landslides were radiocarbon-dated from buried organic material and occurred between 3200 and 900 BP. The more recent landslides were dendrochronologically dated. They were formed in less than 30 years, i.e. in 1818 (2 synchronous landslides), 1839 and 1846. These 19th-century landslides were dated through a comparative analysis of growth curves derived from the buried trees found in the flowing sediments, with the master chronologies from Jacoby and Parker et al, and the northern Quebec light-ring chronology, more specifically the 1816 and 1817 light-ring years. The 1818 landslides occurred during the growing season (July), whereas the 1839 and 1846 landslides were formed during springtime. The occurrence of numerous landslides during this short interval seem to be related to sustained cool and humid climatic conditions that may have enhanced the subsoil water content.

38024 (CONF-8608141—, pp 291-297e) **Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests.** Kaiser, K.F. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The Daettnau late glacial forest is located in a drainage channel formed by melted ice between the Rhine-Lake of Constance Glacier and the Rhine-Linth Glacier to the SW of Win-

terthur, Switzerland. Buried wood from birches and pines, pollen and mollusc deposits laid down during the Late Glacial and extending into the early Boreal after the transition to the Post-glacial were studied. It was possible to reconstruct the vegetational and climatic developments. The Late Glacial in Central Europe is seen to have comprised two intervals: the continuous, moist, warm Boelling/Alleroed zone, and the subsequent dry, cold Younger Dryas. The beginning of the Boelling is clearly indicated by fossil wood, pollen and mollusc remains, as is the transition from Alleroed to the Younger Dryas. The subsequent change-over to the Post-glacial is reflected in the pollen record. The firs $\delta^{18}O$ measurements ever made on land snails show a clear distinction between Alleroed and the Younger Dryas. The large coincidence between Daettnau and other location shows, that the development of this late-glacial forest cannot be classified as a purely local occurrence. It can only be explained as a result of large-scale climatic changes. In contrast to the Daettnau, the Two Creeks Forest evolved into wide open country. The trees found more variability in their local growing conditions, a fact which makes dendrochronological correlation very difficult. While the Daettnau pines held out in the shelter of a drainage channel for one and a half millenia, the growth of the Two Creeks Forest lasted only a bit longer than two centuries. 19 references, 9 figures.

38025 (CONF-8608141—, pp 298-318) **Dendrochronological study of oak trunks found in bogs in northwest Germany.** Leuschner, H.H.; Delorme, A.; Hoefle, H.C. (Univ. of Goettingen, West Germany). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Altogether, 977 subfossil oak trunks from 44 bogs in Lower Saxony have been dendrochronologically analyzed and provide a continuous chronology from 5543 BC to 928 AD. Profile description of the trunk-bearing horizons and analysis of the accompanying peat indicate that the oaks grew on mineral soil and were later preserved in growing peak or they grew on fen during dry periods. In the latter case, they were irregularly distributed in fenwoods consisting primarily of alders and birches. Periods of waterlogging associated with an increase in peat growth resulted in the demise of the oaks. Climate fluctuations caused oaks to die off over wide areas, later becoming covered by peat. These phases occurred especially in the following periods: 4900-4400 BC, 1750 - 1525 BC, 300 - 100 BC, and 330 - 550 AD. 24 references, 7 figures.

38026 (CONF-8608141—, pp 319-326) **Productivity in fossil forests.** Creber, G.T.; Francis, J.E. (Univ. of London, England). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Fossil wood is found abundantly throughout the geological column from the Upper Devonian to the present day. Much of its is in the form of Loose trunks, branches and roots but occasionally the actual stumps of a fossil forest have become fossilized in situ. If growth rings are discernible in the stumps, the productivity can be estimated and related to the light energy input to the forest. Total forest productivity may be estimated from bole productivity. Single-tree productivity may be calculated from isolated trunks or stumps in which the rings can be measured. The productivity may be expressed as the quantity of wood produced in one year by unit area of the cambium. From this figures a minimum light-intercepting area of the crown may be estimated. Another method which may be used utilizes both the ring width and the radius of the cambial cylinder that gives rise to the ring. 18 references, 4 figures, 2 tables.

38027 (CONF-8608141—, pp 327-336) **Tree-ring studies and the reconstruction of woodland management practices in antiquity.** Crone, A. (Univ. of Sheffield, Yorkshire, England). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

By the early Medieval period a system of management, known as coppice-with-standards, had evolved, representing the optimal exploitation of the fragment of remaining woodland. The main feature of this system was the exploitation of relatively large areas of coppiced wood. Coppicing exploits the fact that virtually all native British deciduous trees, when felled, produce vigorous new shoots from the stump. Coppiced stems are characterized by their rapid growth rates branch-free morphology and an unusually wide inner ring, indicative of the exceptional rate of their first year's growth. This paper is addressed specifically to the problem of detecting formal coppicing from the patterns preserved in wood from archaeological contexts and differentiating between this and the adventitious harvesting of naturally occurring coppiced wood.

38028 (CONF-8608141—, pp 337-342) **Dendrochronology and documents in Exeter, South West England.** Mill, C.M. (Sheffield Univ., England). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A wealth of oak (Quercus spp.) timers are preserved in the medieval roofs of Exeter Cathedral with 160 trusses above the high vaults alone. Altogether these contain about 1500 timbers, a significant proportion of which retain some or all of their sapwood. A remarkable series of contemporary medieval documents relating to the cathedral's construction in the thirteenth and fourteenth centuries have survived. These fabric accounts give week by week details of the sums spent on labor and materials, and often mention the source woodland and felling dates for batches of timbers being brought to the cathedral. Obviously, this type of information greatly enhances the potential of the timber assemblage and may enable the study of some particular problems associated with giving and interpreting dates of oak timbers. The research also aims to clarify the roof-building sequence. The architectural history of the cathedral has been the subject of many studies and the fabric accounts give much relevant detail. However the accounts for some years are missing and many entries are obscure and difficult to interpret, so there remain areas of uncertainty which dendrochronology may be able to resolve. Tree-ring dates may also be able to explain some puzzling features of the roof structure.

38029 (CONF-8608141—, pp 343) **Tree-ring reconstruction of Indian-Cree tree harvesting in the area, Quebec, Poste-de-la-Baleine.** Delwaide, A.; Filion, L. (Universite Laval, Sainte-Foy, Quebec). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The development of subarctic white spruce forests around Poste-de-la-Baleine has been controlled in part by Indian and Hudson's Bay Company activities, as indicated by a dendroecological analysis. About 200 Indian camp-sites and cutting areas were dendrochronologically dated and mapped. Three major periods of forest use were defined. Before 1953, the cutting activities were mostly done during the summer season. Heating of Hudson's Bay Company houses most likely the primary cause of the important tree cuttings that occurred during this period. Between 1954-1973, the forests have been progressively influenced by Indian activities. The cutting operations were increasing, particularly around the village, which suggests that wood was carried there in a significant amount as a domestic fuel. Since 1973, an important decrease in wood use was noticed, most likely associated with a shift in cultural change. Several ecological impacts of tree cutting on subarctic forests were evaluated. The vegetation response to these impacts has been 1. the development of distinctive growth-forms associated with traumatic reiterations, 2. a significant growth release in trees living close to the cutting sites, and 3. local successional tree regeneration process, associated with climate, clearing intensity, and physical conditions of ground vegetation following cutting.

38030 (CONF-8608141—, pp 401) **Environmental stresses and residual variation in European tree-ring data after climatic influence is removed.** Braeker, O.U. (Swiss Forest Research Institute, Birmensdorf). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The European network of 104 subalpine sites with recent chronologies of 200-300 years has been condensed into 23 regional

chronologies. These regional chronologies have been used with climatic information to establish climatic models. The application of defined models is used to calculate estimates of ring-widths and densities and to calculate residuals. The residuals (as non-climatic information) are discussed in relation to ecological and anthropogenic changes. The Swiss sample-network of tree-cores in the SANASILVA-inventory of 1984 has been measured. The ring-widths are discussed on a regional and local level in relation to increased environmental stresses (forest decline).

38031 (CONF-8608141—, pp 647-650) **Direct reading x-ray densitometer.** Jozsa, L.A.; Myronuk, R.S. (Forintek Canada Corp., Vancouver, British Columbia). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A Direct Reading X-Ray Densitometry (DRXRD) system was designed in conjunction with a special sample preparation saw capable of cutting unmounted five mm diameter increment cores. The first phase of the work was to evaluate present-day technology that utilized either a radioactive isotope or an X-ray energy source for measuring wood density directly, i.e., not using photographic processes. The second phase of this project was to design the new Forintek DRXRD system. To be cost-effective and to ensure reliability the design was to incorporate off-the-shelf items wherever possible. The DRXRD was to include the following main components; X-ray energy source with a power supply, wood sample transport system, X-ray detector and amplifier, sample imaging system, and a safety interlock circuitry.

38032 (CONF-8608141—, pp 651-657) **Thin-section technique for X-ray densitometric analysis of narrow tree-ring series.** Telewski, F.W.; Burns, J.M.; Ulan, L. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

A technique for thin sectioning wood for X-ray densitometric analysis is described. The method uses a modified sliding micr,tome and is capable of cutting uniform strips of wood between 0.40 and 0.06 mm thick. A thinner section of wood increases the resolution of narrow tree-ring series by reducing small variability in fiber angle associated with axial tracheids and ring boundaries and by reducing the amount of X-ray scatter within the wood sample. The technique also reduces the amount of processing time associated with other methods of sample preparation during cutting. 4 references, 4 figures, 2 tables.

38033 (CONF-8608141—, pp 658-665) **Progress in the image analysis of tree rings.** Yanosky, T.M.; Robinove, C.J.; Clark, R.G. (Geological Survey). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Ring boundaries of increment cores were mapped automatically on digitized images by a convolution filter that emphasizes differences in surficial brightness between latewood and earlywood. Pixel brightness values were also measured along radial and tangential parts of individual rings and ring series. Brightness mapping and profiling can be used to detect and measure structural features correlative with factors affecting ring development, and may possibly generate data for long-term climatic reconstructions. Problems and suggestions for future research are discussed. 2 references, 4 figures.

38034 (CONF-8608141—, pp 666-670) **How to observe tree-ring without really cutting.** Onoe, M. Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

The authors have found computed tomography (CT) is an ideal nondestructive method for observing tree-rings. CT is a technique to reconstruct a true crosssectional distribution of some physical property of a test object from a set of projection data. Projection is a line integral of the distributed property along a certain angle of view. A number of projections at different positions and angles are necessary to yield an acceptable reconstruction. These projections can be physically measured from the outside of the test object. For the measurement of projections, any ray or particles, which are strong enough to pass through an object, may be used.

38035 (CONF-8608141—, pp 671-689) **Potential in using elemental concentrations in radial increments of old growth eastern red cedar to examine the chemical history of the environment.** Guyette, R.; McGinnes, E.A. Jr. (Univ. of Missouri, Columbia). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Research examines the potential of utilizing elemental concentrations in the wood of eastern red cedar (Juniperus virginiana L.) to make inferences about past changes in atmospheric and site chemistry. Crossdated growth increments from live trees and remnant wood are analyzed by neutron activation analysis (NAA) and inductively coupled plasma optical emission spectroscopy (ICP Scan) for elements with potential environmental information. Radial heartwood ring series from 300 to 700 years in length are analyzed in 20 year increments for 37 different elements. Evidence for minimal radial translocation of elements in the heartwood is presented. The radial concentration of elements in the bole is found to be coincident with early smelting activities. 7 references, 4 figures.

38036 (CONF-8608141—, pp 707-717) **Method to obtain thin cross-sections for tree-ring analysis.** Biondi, F. (Univ. of Arizona, Tucson). Apr 1987. NTIS, PC A99/MF A01. File Number DE87009045.

From Industrial symposium on ecological aspects of tree ring analysis; Tarrytown, NY, USA (17 Aug 1986).

Wood cross-sections 1.2-2.0 mm thick were obtained using a common radial arm saw. A special clamp mounted on the saw table and connected to an air compressor held the wood specimen in place during each saw cut. The maximum depth of the saw cut limited the vertical dimension of the specimen, while the size of the saw table and the mutual position of saw and clamp limited the two horizontal dimensions of the specimen. A pipe covered with mosquito-net and connected to a vacuum source was used to catch the thin section when cut. High quality thin sections of both angiosperms and conifers were easily prepared and used for tree-ring dating and ring-width measuring. Thin transverse sections are easily stored and transported in large numbers even if the available room is small. Their minimal size and weight simplify any operation that requires handling a lot of wood cross-sections. 12 references, 11 figures, 1 table.

38037 **(LBL—23477) MINC [Multiple Interacting Continua]: An approach for analyzing transport in strongly heterogeneous systems.** Narasimhan, T.N.; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 21p. (CONF-8706137—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011224.

From NATO advanced research workshop on advances in analytical and numerical groundwater flow and quality modeling; Lisbon, Portugal (2 Jun 1987).

We consider systems in which materials of low-diffusivity occur as islands in pervasive high-diffusivity materials. In these systems, global three dimensional transport occurs in the high-diffusivity materials. Transport in the low-diffusivity materials is local and one-dimensional in nature. MINC (Multiple Interacting Continua) is a method for efficiently simulating transport in such systems. The Integral Finite Difference Method (IFDM) provides a convenient way for implementing MINC. Known information on the shape and the size of the blocks can be judiciously utilized to obtain improved accuracy in estimating transport into the islands. MINC permits handling of continua at several hierarchial levels.

38038 **(NEI-DK—28) Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn.** Reeh, N.; Thomsen, H.H. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Aug 1986. 37p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752472.

This report describes a model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the mar-

ginal zone of the Inland Ice. The model has been developed to investigate whether the natural variation in the isotopic composition of the surface ice can give information about the extent of the hydrological basins on the Inland Ice. The meltwater drainage systems on the ice margin are described, and the problems involved in delineating the drainage basins are mentioned. The background for the model is given in term of a description of the natural variation in the isotopic composition of the surface ice of the ice margin. Previous applications of stable isotope studies related to glacier-hydrological investigations in Greenland are shortly reviewed. The results of the simulation for the marginal zone of the Inland Ice at Pakitsup akuliarusersua indicate that isotope studies can contribute useful information about the area versus elevation distribution and the development of the ablation area through the melt season. The differences between the observed isotope ratios of water samples from three proglacial lakes are qualitatively in agreement with the corresponding differences, and the deviations between observed and simulated values can be understood. Collection of additional isotope data in the area will improve the quality of the simulation and thereby provide background for safer conclusions as regards the delineation of the hydrological drainage basins on the Inland Ice. (EG).

38039 **(ORNL/TM—10112) Subsurface-controlled geological maps for the Y-12 plant and adjacent areas of Bear Creek Valley.** King, H.L.; Haase, C.S. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011961.

Bear Creek Valley in the vicinity of the US Department of Energy Y-12 Plant is underlain by Middle to Late Cambrian strata of the Conasauga Group. The group consists of interbedded limestones, shales, mudstones, and siltstones, and it can be divided into six discrete formations. Bear Creek Valley is bordered on the north by Pine Ridge, which is underlain by sandstones, siltstones, and shales of the Rome Formation, and on the south by Chestnut Ridge, which is underlain by dolostones of the Knox Group. Subsurface-controlled geological maps illustrating stratigraphic data and formational contacts for the formations within the Conasauga Group have been prepared for the Y-12 Plant vicinity and selected areas in Bear Creek Valley westward from the plant. The maps are consistent with all available surface and subsurface data for areas where sufficient data exist to make map construction feasible. 13 refs.

38040 **(TVA/ONRED/AWR—87/6) Floods on East Fork Mulberry Creek and Price Branch in the vicinity of Lynchburg, Tennessee.** (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Nov 1986. 54p. NTIS, PC A04/MF A01. File Number DE87900851.

This flood hazard information report describes the extent and severity of the possible flooding along selected reaches of those streams listed above for watershed and channel conditions as of March 1986. It was prepared by TVA in response to a request from the town of Lynchburg for up-to-date information regarding the flood potential along the studied stream reaches in order to assist the town to better administer its floodplain management program. Detailed information is provided concerning the current flood threat along the studied stream reaches. The report does not propose plans for the solution of identified flood problems. Rather, it provides the flood information needed to make informed decisions regarding the use of flood-prone lands within the study area.

## 5802 Geophysics

*REFER ALSO TO CITATION(S) 36523, 36928, 37597*

38041 **(AD-A—179539/2/XAB) Studies of infrared aurorae. Technical report.** Fox, J.L. (Utah State Univ., Logan (USA). Center for Space Engineering). 3 Nov 1986. 51p. (CSE—86-139). NTIS, PC A04/MF A01.

Smithsonian researchers began their studies of infrared aurorae by computing the rate of vibrational excitation of $N_2$ by the impact of energetic electrons. Although the radiative lifetime of vibrationally excited $N_2$ is long, infrared emission may appear as a result of V-V transfer from $N_2$ to molecules that may radiate, such as $CO_2$ and NO. A complete set of cross sections was compiled for electron-impact excitation of vibrational levels $v = 1$ through $v = 6$ for the impact of electrons with energies from 2 to 200 eV. They found that for high electron energies and low fractional ionizations, about 6% of the total energy of the electron appears as vibrational excitation.

38042 **(IFP—33-507) Numerical simulation of marine seismic source signature and of their interaction. Application to the watergun.** Le Mentec, O. (SEE CODE- 9100855 Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 20 Sep 1985. 150p. (In French). NTIS (US Sales Only), MF A01. File Number DE87751771.

A marine seismic source creates one or many bubbles in water. The bubble movement generates an acoustic wave which propagates first in water and then underground. To simulate: a source signature creating an isolated bubble, we present, analyse, and fit the "spherical model" to explosive and implosive source case. The interaction phenomenon is related to bubble deformation during their movements. The simulation method has been fitted to the water gun HWG400. Stages of the simulation are:water jet modelling, bubble evolution simulation, two bubble interaction modelling. The algorithm developed allows to simulate signature and spectrum of a set of water guns, whatever is the source and hydrophone position.

## 5803 Mineralogy, Petrology, And Rock Mechanics

*REFER ALSO TO CITATION(S) 36390, 36391, 36392, 36393, 36394, 36398, 36399, 36403, 36443, 36449, 36455, 36522, 36537*

38043 **(LBL—22718) Hydraulic and mechanical properties of natural fractures in low-permeability rock.** Pyrack-Nolte, L.J.; Myer, L.R.; Cook, N.G.W.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 10p. (CONF-870815—2). NTIS, PC A02. File Number DE87006147.

From 6. International Society for Rock Mechanics congress; Montreal, Canada (30 Aug 1987).

The results of a comprehensive laboratory study of the mechanical displacement, permeability, and void geometry of single rock fractures in a quartz monzonite are summarized and analyzed. A metal-injection technique was developed that provided quantitative data on the precise geometry of the void spaces between the fracture surfaces and the areas of contact at different stresses. At effective stresses of less than 20 MPa fluid flow was proportional to the mean fracture aperture raised to a power greater than 3. As stress was increased, contact area was increased and void spaces become interconnected by small tortuous channels that constitute the principal impediment to fluid flow. At effective stresses higher than 20 MPa, the mean fracture aperture continued to diminish with increasing stress, but this had little effect on flow because the small tortuous flow channels deformed little with increasing stress.

38044 **(LBL—22747) Generation and analysis of stable excavation shapes under high rock stresses.** Ewy, R.T.; Kemeny, J.M.; Zheng, Z.; Cook, N.G.W. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Jan 1987. Contract AC03-76SF00098. 11p. (CONF-870815—3). NTIS, PC A02. File Number DE87006944.

From 6. International Society for Rock Mechanics congress; Montreal, Canada (30 Aug 1987).

Failure criteria based on micromechanical models of splitting failure and shear failure are implemented in boundary element programs to analyze the stability of various two-dimensional excavation shapes under high stress. A technique for modeling the failure processes of progressive spalling, shear, and tensile failure is developed and is used to simulate the formation of stable shapes through progressive failure. The shapes resulting from initially circular openings are strikingly similar to those recognized widely as wellbore breakouts. All the shapes studied lead to the formation of

pointed breakout regions, and these final shapes are stable with respect to splitting, shear, and tensile failure. The size of the failed region is smaller for the case of gradually increasing field stress around a preexisting opening than for an opening made instantaneously in rock with preexisting stress.

38045 **(PNL-SA—14276) Trace rare earth element analysis in briny groundwaters.** Laul, J.C.; Lepel, E.A.; Smith, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 5p. (CONF-870430—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011185.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A rare-earth element (REE) group separation scheme has been developed. REE data for two briny groundwaters representing Granite Wash and Wolfcamp Carbonate formations are reported. (DLC)

38046 **(SAND—85-7100) The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project.** Labreche, D.A.; Petney, S.V. (RE/SPEC, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011576.

A deformable continuum joint model, the Compliant Joint Model, has been incorporated into the two-dimensional finite-element computer program SPECTROM-31. The stress-deformation response of a joint set normal to its plane of orientation is elastic and hyperbolic in form. The shear stress-deformation response of the joint set tangent to its plane of orientation is linear elastic. The response of up to four arbitrarily oriented joint sets is combined with the linear elastic response of the matrix component of the model to form an anisotropic nonlinear elastic composite material. The inherent numerical difficulties associated with the iterative solution of complex problems with such nonlinear models led to a preliminary investigation of the feasibility of employing the Compliant Joint Model in large finite-element models. Primary factors affecting the degree of difficulty in obtaining the numerical solution were identified as the initial stress state and loading history, joint orientation and degree of dispersion, and degrees of freedom in the model. The collective importance of these factors focuses on their effect on the composite stiffness of the material and the associated potential for an ill-conditioning of the stiffness matrix. 6 refs., 6 figs., 9 tabs.

38047 **(SAND—87-1227) A finite element material model for microfracture-damaged brittle rock.** Costin, L.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012511.

A continuum damage model based on the mechanics of microcrack growth has been implemented in the finite element code SANCHO. The model incorporates the effects of the nucleation, growth and coalescence of microcracks on the deformation of brittle materials, such as rock, under compressive loading. The material subroutine keeps track of both the magnitude and direction of microcrack growth in each element so that the induced anisotropy due to crack growth in preferred directions and the stress history dependence of microcrack growth are properly taken into account. In addition, the model allows for interaction among neighboring microcracks, which leads to coalescence and subsequent material failure or softening. A damage vector, which is calculated from the crack distribution in each element, is used as an internal variable to compute the effective elastic moduli at each stage of the deformation. Results of several sample calculations using the model are presented and methods for determining the required material parameters are discussed.

38048 **(UCRL—96585) Brittle fracture phenomena: An hypothesis.** Britton, K.; Walton, O.R. (Lawrence Livermore National Lab., CA (USA)). 1 May 1987. Contract W-7405-ENG-48. 24p. (CONF-870867—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010247.

From 2. international symposium on rock fragmentation by blasting; Keystone, CO, USA (23 Aug 1987).

It is proposed that: volumetric dilation is a fundamental requirement for brittle fracture involving shear; such dilation commonly involves or is expressed as zonal overpressures; the overpressured zones radiate particle motions which are significant to or dominate seismic radiation from blasting; the overpressures are commonly significant to and may dominate the energetics of blastings. Outstanding problems and gaps in our knowledge regarding fragmentation are discussed. It is argued that there is a common missing factor, dilatancy. Supporting evidence is presented from soils and rock mechanics, blasting experimental data and blasting experience. Computer modeling of fragmentation is discussed and the necessity for the inclusion of dilatancy established. Implications are discussed and a test of the hypothesis proposed.

### 5804 Geochemistry

*REFER ALSO TO CITATION(S) 36478, 36526*

### 5805 Oceanography

*REFER ALSO TO CITATION(S) 36536*

38049 **(BNL—52071) Shelf Edge Exchange Processes: Phase 1 (SEEP-1), Hydrography report, July 1983-October 1984.** Behrens, W.J.; Flagg, C.N. (Brookhaven National Lab., Upton, NY (USA)). Dec 1986. Contract AC02-76CH00016. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011897.

This report presents hydrographic data collected as part of the first phase of the Shelf Edge Exchange Processes (SEEP) program. The SEEP program is a multi-institutional effort to investigate the flux of suspended material from the continental shelf into the waters of the upper slope and thence, possibly, into the slope sediments. During the field portion of the program, current, temperature, conductivity, fluorescence, and transmission sensing instruments were deployed across the outer continental shelf and onto the continental slope. 382 CTD casts were made where temperature, salinity, dissolved oxygen, transmission, and fluorescence data were collected. Expendable bathythermograph (XBT) data were collected sporadically but are not included in this report. This report describes the processing and calibration of the CTD data and presents the data in a series of representative temperature and salinity correlation diagrams and cross-isobath transects.

## 64 PHYSICS I

*REFER ALSO TO CITATION(S) 36972*

### 6401 Astrophysics And Cosmology

*REFER ALSO TO CITATION(S) 38084, 38098, 38193, 38205, 38247, 38248, 38285*

38050 **(AD-A—179331/4/XAB) Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986.** Helfand, D.J. (Columbia Univ., New York (USA). Columbia Astrophysics Lab.). Dec 1986. 14p. (CAL—1629). NTIS, PC A02/MF A01.

Our program of multiwavelength observational investigations and their attendant interpretive studies concerning problems in stellar coronae, supernova remnants, and neutron-star astrophysics continued in FY 86. A variety of important projects were undertaken, several of which reached completion in the last year of the five-year period (1 October 1981 to 30 September 1986), including the compilation of the complete x-ray flux-limited sample of M stars, a study of small-scale anisotropy of the extragalactic x-ray background, and a definitive paper on the new class of composite SNRs. A total of 26 papers presenting the results of the program were published or accepted for publication in the technical literature, as well as six review articles for conference proceedings. A total of 35 presentations were given at regional, national, and international meetings by the principal investigator, two co-investiga-

tors, and/or the six graduate students supported under this program. In addition, radio and optical observations under several existing proposals were conducted and more than twenty new proposals were prepared, the majority of which have already been accepted.

38051 **(AD-A—179513/7/XAB) High-energy neutral radiations from the sun.** Chupp, E.L. (New Hampshire Univ., Durham (USA). Dept. of Physics). 1984. 16p. NTIS, PC A02/MF A01.

Pub. in Annual Review Astronomy Astrophysics, Vol. 22, 359-387(1984).

Only recently with the launch of the Solar Maximum Mission and Hinotori satellites, has it been possible to routinely detect high-energy neutral (gamma ray and neutron) radial ions from the sun to identify them with confidence, and to study their properties. The new observations require revisions in earlier concepts, particularly those concerning particle acceleration. This review describes SMM and other relevant observations, and discusses some of the exciting implications and questions that these data raise.

38052 **(AD-A—179545/9/XAB) Vector-array-processor computer equipment. Final report, 1 January-31 December 1985.** Toomre, J. (Colorado Univ., Boulder (USA). Dept. of Astrophysical, Planetary, and Atmospheric Sciences). 6 Feb 1987. 16p. NTIS, PC A02/MF A01.

To support the on-going research on Solar Oscillations and Convective Flows as Probes of Structure in the Subphotosphere, a vector-array-processor system was acquired to augment the existing DEC VAX-11/750 computer system. The fifty-fold average increase in computing speed offered by the array processor would make it feasible to invert solar-oscillation data on a regular basis, and thereby permit use of the five-minute oscillations of the Sun to probe the turbulent convection zone below the surface. The array processor also permits detailed numerical experiments with compressible convection in the presence of magnetic fields, for the speed and memory of the machine makes it a formidable tool for direct numerical simulations of two- and three-dimensional fluid dynamics. Such theoretical simulations are also needed to study the solar dynamo and its ability to build and transform magnetic fields, an issue central to solar-terrestrial variablility and predictions of solar activity. Attached as Appendix A is a cover article in Science Magazine that describes the importance of the work on the Seismology of the Sun that is beginning to emerge from the class of array processors.

38053 **(AD-A—179584/8/XAB) Very Large Array observations of the sun with related observations using the SMM (Solar Maximum Mission) satellite. Interim report, 1 January-31 December 1986.** Lang, K.R. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 31 Jan 1986. 81p. NTIS, PC A05/MF A01.

Observations of solar-active regions with the Very Large Array (VLA) and with the Solar Maximum Mission (SMM) satellite are providing new insights to the origin and prediction of solar activity. This activity includes bursts or flares that can disrupt the tracking of satellites, distort communication systems, and interfere with high-flying aircraft. These bursts originate in coronal loops that are uniquely studied with the VLA (at 20 cm wavelength) and with the SMM (at x-ray wavelengths). The research summarized includes discussions of coronal diagnostics, solar-burst precursors, and energy buildup in coronal loops. Novel discoveries of coherent burst mechanisms on nearby active stars other than the sun. VLA observations of a solar-noise storm (at 92-cm wavelength) have resolved the sources of storm radiation for the first time. Future VLA observations with the new 92-cm system will provide new information about the unknown processes that trigger and continually excite solar noise storms, while also providing insights to the unknown triggering mechanisms for decimetric bursts and coronal mass ejections. This report includes reprints, preprints or abstracts of articles prepared under this grant.

38054 **(AD-A—179650/7/XAB) Solar-active region physical parameters inferred from a thermal cyclotron line and soft-x-ray spectral lines.** Lang, K.R.; Willson, R.F.; Smith, K.L.; Strong, K.T. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1986. 22p. NTIS, PC A02/MF A01.

Simultaneous high-resolution observations of coronal loops are presented at 20-cm wavelength with the Very Large Array and at soft-x-ray wavelengths. The images at 20-cm and soft-x-ray wavelengths have nearly identical sizes and ellipsoidal shapes, with a linear extent of about 5 cm. This emission stretches between and across regions of opposite magnetic polarity in the underlying photosphere. Complete x-ray coronal loops can therefore be imaged at 20 cm, and the VLA maps describe the radio wavelength counterpart of x-ray coronal loops. x-ray spectral lines were used to obtain values of electron temperature and electron density averaged over the emitting area. The absence of detectable circular polarization is consistent with an optically thick plasma. The observed brightness temperature was roughly equal to the electron temperature of the coronal plasma. The VLA maps at 10 closely spaced frequencies between 1440 and 1720 MHz describe the same coronal loops or arcades of loops. A plot of the maximum-brightness temperature of these loops as a function of observing frequency exhibits a line-like feature with a central frequency of 1650 MHz and a half width of 80 MHz. This spectral feature is attributed to a thermal-cyclotron line and indicates that the optical depth of thermal gyro-resonance radiation must be greater than that of thermal bremsstrahlung at these frequencies.

38055 **(AD-A—179664/8/XAB) VLA (Very Large Array) observations of a solar-noise storm.** Lang, K.R.; Willson, R.F. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1986. 20p. NTIS, PC A02/MF A01.

The first Very Large Array (VLA) observations of the sun at 92-cm wavelength (328 MHz) are presented. A solar-noise storm, which lasted at least 3 hours, was detected at this wavelength; it consisted of burst-like spikes superimposed on a slowly varying background, and both storm components were 95 + or - 5% right-hand circularly polarized. A long-duration soft-x-ray event preceded the radio radiation by 30 m, suggesting a disturbance moving outwards at a velocity of v = 78 km/s. The 92-cm noise storm was resolved with an angular resolution of 9 sec for time intervals as short as 13 s. During the onset and early phases, the storm consisted of four compact sources, each with an angular diameter of 40 sec, oriented within an elongated source with angular dimensions of 40 sec by 200 sec. During the subsequent hour, the most-intense emission was located in two 40-sec sources separated by 100 sec. Snapshot maps revealed a persistent elongated source at successive peaks, with a scatter in the source position. A systematic position shift of Deta Theta/sub I/ > or = 15 sec can be produced by the Earth's ionosphere, but these effects can be removed by frequent observations of a nearby calibrator source. The observations confirm previously reported trends for a decrease in source size at higher frequencies, but they suggest a hitherto unresolved complexity in source structure.

38056 **(AD-A—179698/6/XAB) Simultaneous SMM flat-crystal spectrometer and Very Large Array observations of solar-active regions.** Lang, K.R.; Willson, R.F.; Smith, K.L.; Strong, K.T. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1986. 27p. NTIS, PC A03/MF A01.

High-resolution images of the quiescent emission from two solar-active regions are compared at 20-cm (VLA) and soft-x-ray (SMM-FCS) wavelengths. There are regions where the x-ray coronal loops have been completely imaged at 20-cm wavelength. In other regions, the x-ray radiation was detected without detectable 20-cm radiation, and vice versa. The x-ray data were used to infer average electron temperatures Te of about 3,000000 K and average electron densities of about 2.5 x $10^9/cm^3$ for the x-ray-emitting plasma in the two active regions. The thermal bremsstrahlung of the x-ray-emitting plasma is probably optically thin at 20-cm wavelength. Although the 20-cm brightness temperatures TB were always less than Te, suggesting optically thin layers, the thermal gyroresonance radiation from the x-ray-emitting plasma ought to be

optically thick at 20-cm wavelength. The low TB can be explained if a higher, cooler plasma covers the hotter x-ray-emitting plasma. Thermal gyroresonance radiation must account for the intense 20-cm radiation near and above sunspots where no x-ray radiation is detected. The potential of 20-cm (VLA) and soft x-ray (SMM-FCS) comparisons is discussed.

38057 **(DOE/ER/40272—32) On the evolution of global strings in the early universe.** Harari, D.; Sikivie, P. (Florida Univ., Gainesville (USA). Dept. of Physics). [1987]. Contract FG05-86ER40272. 13p. (UFTP—87-4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008766.

We find that a bent global string straightens itself out by dissipation into Nambu-Goldstone (NG) bosons in the order of one oscillation time and that the spectrum of radiated NG bosons is 1/k. In the early universe, the assumption that there is one global string per causal horizon is justified after an initial period during which the effect of the primordial plasma on the motion of the strings is non-negligible. We find that the upper bound that axion radiation by strings places on the axion decay constant is comparable to, but not more stringent than the one derived from coherent oscillations of the axion field, i.e., f/sub a/ $\leqq 10^{12}$ GeV. We also discuss the model-dependence of this bound. 12 refs.

38058 **(FNAL/Pub—87/77-A) Cosmic strings in an expanding spacetime.** Stein-Schabes, J.A.; Burd, A.B. (Fermi National Accelerator Lab., Batavia, IL (USA); Sussex Univ., Brighton (UK)). Apr 1987. Contract AC02-76CH03000. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010939.

We investigate the stability of a static, infinitely long and straight vacuum string solution under inhomogeneous axisymmetric time-dependent perturbations. We find it to be perturbatively stable. We further extend our work by finding a string solutions in an expanding Universe. The back reaction of the string on the gravitational field has been ignored. The background is assumed to be a Friedman-Robertson-Walker (FRW) cosmology. By numerically integrating the field equations in a radiation and matter dominated models, we discover oscillatory solutions. The possible damping of these oscillations is discussed. For late times the solution becomes identical to the static one studied in the first part of the paper. 19 refs., 8 figs.

38059 (N—87-20665, pp vp) **Forecasts of solar and geomagnetic activity.** Joselyn, J. Feb 1987. NTIS, PC A13/MF A01. (NASA-CP—2460; M—548; NAS—1.55:2460).

In Upper and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations.

Forecasts of solar and geomagnetic activity are critical since these quantities are such important inputs to the thermospheric density models. At this time in the history of solar science there is no way to make such a forecast from first principles. Physical theory applied to the Sun is developing rapidly, but is still primitive. Techniques used for forecasting depend upon the observations over about 130 years, which is only twelve solar cycles. It has been noted that even-numbered cycles systematically tend to be smaller than the odd-numbered ones by about 20 percent. Another observation is that for the last 12 cycle pairs, an even-numbered sunspot cycle looks rather like the next odd-numbered cycle, but with the top cut off. These observations are examples of approximate periodicities that forecasters try to use to achieve some insight into the nature of an upcoming cycle. Another new and useful forecasting aid is a correlation that has been noted between geomagnetic indices and the size of the next solar cycle. Some best estimates are given concerning both activities.

38060 (N—87-20665, pp vp) **NASA/MSFC prediction techniques.** Smith, R.E. Feb 1987. NTIS, PC A13/MF A01. (NASA-CP—2460; M—548; NAS—1.55:2460).

In Upper and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations.

The NASA/MSFC method of forecasting is more formal than NOAA's. The data are smoothed by the Lagrangian method and linear regression prediction techniques are used. The solar activity period is fixed at 11 years--the mean period of all previous cycles. Interestingly, the present prediction for the time of the next solar minimum is February or March of 1987, which, within the uncertainties of two methods, can be taken to be the same as the NOAA result.

38061 **(N—87-20860) Collisional dynamics of perturbed particle disks in the solar system. Annual technical progress report.** Roberts, W.W.; Stewart, G.R. (Virginia Univ., Charlottesville (USA)). Mar 1987. 11p. (NASA-CR—180497; NAS—1.26:180497; UVA—528253/AM87/101). NTIS, PC A02/MF A01.

Investigations of the collisional evolution of particulate disks subject to the gravitational perturbation of a more massive particle orbiting within the disk are underway. Both numerical N-body simulations using a novel collision algorithm and analytical kinetic theory are being employed to extend our understanding of perturbed disks in planetary rings and during the formation of the solar system. Particular problems proposed for investigation are: (1) The development and testing of general criteria for a small moonlet to clear a gap and produce observable morphological features in planetary rings; (2) The development of detailed models of collisional damping of the wavy edges observed on the Encke division of Saturn's A ring; and (3) The determination of the extent of runaway growth of the few largest planetesimals during the early stages of planetary accretion.

38062 **(N—87-20947) Statistical aspects of solar flares.** Wilson, R.M. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1987. 41p. (NASA-TP—2714; NAS—1.60:2714). NTIS, PC A03/MF A01.

A survey of the statistical properties of 850 H alpha solar flares during 1975 is presented. Comparison of the results found here with those reported elsewhere for different epochs is accomplished. Distributions of rise time, decay time, and duration are given, as are the mean, mode, median, and 90th percentile values. Proportions by selected groupings are also determined. For flares in general, mean values for rise time, decay time, and duration are 5.2 + or - 0.4 min, and 18.1 + or 1.1 min, respectively. Subflares, accounting for nearly 90 percent of the flares, had mean values lower than those found for flares of H alpha importance greater than 1, and the differences are statistically significant. Likewise, flares of bright and normal relative brightness have mean values of decay time and duration that are significantly longer than those computed for faint flares, and mass-motion related flares are significantly longer than non-mass-motion related flares. Seventy-three percent of the mass-motion related flares are categorized as being a two-ribbon flare and/or being accompanied by a high-speed dark filament. Slow rise time flares (rise time greater than 5 min) have a mean value for duration that is significantly longer than that computed for fast rise time flares, and long-lived duration flares (duration greater than 18 min) have a mean value for rise time that is significantly longer than that computed for short-lived duration flares, suggesting a positive linear relationship between rise time and duration for flares. Monthly occurrence rates for flares in general and by group are found to be linearly related in a positive sense to monthly sunspot number. Statistical testing reveals the association between sunspot number and numbers of flares to be significant at the 95 percent level of confidence, and the t statistic for slope is significant at greater than 99 percent level of confidence.

38063 **(N—87-21763) Research in planetary studies and operation of the Mauna Kea Observatory. Semiannual progress report, January-December 1986.** Cruikshank, D.P. (Hawaii Univ., Honolulu (USA)). Dec 1986. 92p. (NASA-CR—180513; NAS—1.26:180513; SAPR—32; SAPR—33). NTIS, PC A05/MF A01.

The research programs are highlighted in the following areas: major planets; planetary satellites and rings; asteroids; comets; dark organic matter; theoretical and analytical structures; extrasolar planetary; and telescopes.

38064 **(PB—87-173605/XAB) Procedures for reduction of Fe XII 10747 A coronal emission-line polarization observations. Technical note.** Arnaud, J.; Newkirk, G. (National Center for Atmospheric Research, Boulder, CO (USA)). Jan 1987. 25p. (NCAR-TN—278-STR). NTIS, PC A02/MF A01.

The note documents the reducing procedures used to obtain the best estimates of the coronal Stokes parameters from the raw measurements recorded in two spectral channels with the High Altitude Observatory-Sacramento Peak Observatory Coronal Emission-line Polarimeter (KELP). The original reduction programs were modified to survey the KELP data as a whole and to help determine whether corrections are needed for each scan.

38065 **(PB—87-181194/XAB) Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Feb 1987. 99p. (SGD—510-PT-1). NTIS, PC A05/MF A01.

See also Part 2, PB—87-181202 and PB—87-162582.

Contents include: Detailed index for 1986-1987; Data for January 1987--(IUWDS alert periods (Advance and worldwide); Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for December 1986--(Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data--(Solar radio emission December 1986, Cosmic-ray measurements by neutron monitor, Geomagnetic indices).

38066 **(PB—87-181202/XAB) Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Feb 1987. 45p. (SGD—510-PT-2). NTIS, PC A03/MF A01.

See also Part 1, PB—87-181194 and PB—87-162574.

Contents include: Detailed index for 1986-1987; Data for August 1986--(Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments); Miscellaneous data--Interplanetary solar plasma.

38067 **(PB—87-184198/XAB) Sunspot numbers: 1610-1985 based on The Sunspot-Activity in the Years 1610-1960'.** McKinnon, J.A. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Jan 1987. 115p. (UAG—95). NTIS, PC A06/MF A01.

Library of Congress catalog card No. 75-643290.

Contents include: (1610-1985) Minima and Maxima of Sunspot Number Cycles; (1700-1985) Yearly Mean Sunspot Numbers (Table); (1700-1985) Yearly Mean Sunspot Numbers (Graph); (1749-1985) Monthly Mean Sunspot Numbers (Tables); (1749-1985) Monthly Mean Sunspot Numbers (Graph); (1749-1985) Smoothed Monthly Mean Sunspot Numbers (Tables); (1749-1985) Smoothed Monthly Mean Sunspot Numbers (Graph); (1818-1985) Daily Sunspot Numbers (Tables); (1818-1985) Daily Sunspot Numbers (Graph); and UAG Series of Reports.

38068 **(PB—87-186383/XAB) Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Mar 1987. 85p. (SGD—511-PT-2). NTIS, PC A05/MF A01.

See also PB—87-162582 and PB—87-186375.

Contents include: Detailed index for 1986-1987; Data for September 1986-- Meudon Carte Synoptique; Solar flares; Solar radio bursts at fixed frequencies; Solar x-ray radiation from GOES satellite; Mass ejections from the sun; Active prominences and filaments; Miscellaneous data-- Interplanetary solar plasma.

38069 (SLAC—312, pp 607-632) **Discovery of very high energy point sources.** Halzen, F. (CERN, Geneva, Switzerland). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A cosmic accelerator such as Cygnus X-3 has a luminosity of at least one million suns. This observation may resolve the long-standing question of the origin of very high energy cosmic rays. Its flux at Earth is roughly $10^7$ photons $km^{-2}$ $year^{-1}$ with energy 1-$10^5$ TeV. They discuss tagged photon experiments exploring particle structure in this energy range. They show how possible underground muon observation of point sources raises rather than answers questions. They discuss these questions in the context of some recent experimental results.

38070 **(UCRL—96725) The early solar system abundance of $^{244}$Pu as inferred from the St. Severin chondrite.** Hudson, G.B.; Kennedy, B.M.; Podosek, F.A.; Hohenberg, C.M. (Washington Univ., St. Louis, MO (USA). McDonnell Center for the Space Sciences). Mar 1987. Contract W-7405-ENG-48. 37p. (CONF-870396—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010811.

From Lunar and planetary science conference; Houston, TX, USA (16 Mar 1987).

We describe the analysis of Xe released in stepwise heating of neutron-irradiated samples of the St. Severin chondrite. This analysis indicates that at the time of formation of most chondritic meteorites, approximately 4.56 x $10^9$ years ago, the atomic ratio of $^{244}$Pu/$^{238}$U was 0.0068 +- 0.0010 in chondritic meteorites. We believe that this value is more reliable than that inferred from earlier analyses of St. Severin. We feel that this value is currently the best available estimate for the early solar system abundance of $^{244}$Pu. 42 refs., 2 tabs.

38071 **Cosmology with decaying vacuum energy.** Freese, K.; Adams, F.C.; Frieman, J.A.; Mottola, E. (California Univ., Santa Barbara, USA. Inst. for Theoretical Physics; California Univ., Berkeley, USA. Dept. of Physics; California Univ., Berkeley, USA. Dept. of Astronomy; Stanford Linear Accelerator Center, CA, USA; Stanford Univ., CA, USA). *Nuclear Physics [Section] B;* **287**: No. 4, 797-814(15 Jun 1987). Contract AC03-76SF00515.

Motivated by recent attempts to solve the cosmological constant problem, we examine the observational consequences of a vacuum energy which decays in time. In both radiation and matter dominated eras, the ratio of the vacuum to the total energy density of the universe must be small. Although the vacuum cannot provide the 'missing mass' required to close the universe today, its presence earlier in the history of the universe could have important consequences. Element abundances from primordial nucleosynthesis require the ratio x=rho/sub vac//(rho/sub vac/+rho/sub rad/)≦ 0.1 in the radiation epoch; even a nonzero x> or approx. 0.01 at nucleosynthesis, however, can allow the number of neutrino (or equivalent light) species to exceed N/sub $\nu$/>4, a case ruled out in the standard cosmological model. If the vacuum decays into low energy photons, the lack of observed spectral distortions in the microwave background gives tighter bounds, x<4 x 10/sup -4/. In the matter-dominated era, the presence of a vacuum term may allow more time for growth of protogalactic perturbations.

38072 **Possible calorimetric effects at Mercury due to solar wind-magnetosphere interactions.** Baber, D.N.; Borovsky, J.E.; Burns, J.O.; Gisler, G.R.; Zeilik, M. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. A5, 4707-4712(1 May 1987).

As a result of the solar wind interaction with the magnetosphere of Mercury, we expect several effects which may be observable with ground-based and/or near-earth radio and infrared telescopes: (1) there may be direct interaction of the solar wind with the surface of Mercury which could produce measurable heating effects; (2) substormlike magnetotail processes within Mercury's magnetosphere may precipitate particles carrying from 10/sup 10/ to 10/sup 12/ W (or more) of power into narrow latitudinal bands on the cold (approx. <130 K) darkside of Mercury, producing surface-heated "auroral" zones; and (3) the presence of Jovian electrons within the inner Hermean magnetosphere may produce transient, very low frequency synchrotron-emitting radiation belts. Hence remote radio and infrared observations hold substantial promise for providing information about the intrinsic properties of Mercury's magnetic field, about the planetary surface, and about the dynami-

cal interaction of the Hermean magnetosphere with the solar wind at —0.4 AU. Copyright American Geophysical Union 1987.

38073 **EXOSAT observations of double-peaked bursts with radius expansion from 4U/MXB 1820-30.** Haberl, F.; Stella, L.; White, N.E.; Gottwald, M.; Priedhorsky, W.C. (EXOSAT Observatory, Darmstadt, West Germany; ESA, Space Science Dept., Noordwijk, Netherlands; Los Alamos National Lab., NM; Max-Planck-Institut fuer Physik und Astrophysik, Garching, West Germany). *Astrophysical Journal;* **314**: 266-271(Mar 1987).

A detailed analysis is presented of seven X-ray bursts from the X-ray source 4U/MXB 1820-30 in the globular cluster NGC 6624. The bursts were double-peaked, and recurred at almost equal time intervals of 3.2 hr. The persistent flux varied by only 10 percent on time scales of 60 minutes. The ratio of the total persistent energy emitted before a burst to the total energy released by a burst varied between 125 and 155. The inferred blackbody radius for the burst spectra showed large variations, increasing from 10 to 200 km within the first 0.25-1.5 s, accompanied by a decrease in spectral temperature from 1.2 to 0.4 keV. The inferred source radius during burst decay was constant at about 10 km. This radius is interpreted as the size of the neutron star. During the radius expansion phase, the luminosity remained constant at a mean value of 2.5 x 10 to the 38th ergs/s, which is consistent with the helium Eddington limit for a 10 km, 1.4 solar mass neutron star. 30 references.

38074 **X-ray and ultraviolet radiation from accreting white dwarfs. IV. Two-temperature treatment with electron thermal conduction.** Imamura, J.N.; Durisen, R.H.; Lamb, D.Q.; Weast, G.J. (Indiana Univ., Bloomington; Los Alamos National Lab., NM; Illinois Univ., Urbana; Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). *Astrophysical Journal;* **313**: 298-319(Feb 1987).

Results are reported from two-temperature calculations of the structures and X-ray spectra of radiation shocks generated by accretion onto nonmagnetic white dwarfs. The approach was necessitated by the domination of bremsstrahlung in the emission region by Compton cooling. Features of the shock model, which includes steady, spherical infall of fully ionized plasma and dominance of the stand-off shock by collisional processes, are summarized. A maximum hard X-ray temperature of about 50 keV and a maximum hard X-ray luminosity of 2 x 10 to the 36th ergs/sec were obtained. The results prove that the bulk of accretion energy cannot be transported to the star by electron thermal conduction, provided that bremsstrahlung cooling is dominant over cyclotron cooling. 52 references.

38075 **Kinematic tests of exotic flat cosmological models.** Charlton, J.C.; Turner, M.S. (Chicago Univ., IL; NASA/Fermilab Astrophysics Center, Batavia, IL). *Astrophysical Journal;* **313**: 495-504(Feb 1987).

Theoretical prejudice and inflationary models of the very early universe strongly favor the flat, Einstein-de Sitter model of the universe. At present the observational data conflict with this prejudice. This conflict can be resolved by considering flat models of the universe which posses a smooth component of energy density. The kinematics of such models, where the smooth component is relativistic particles, a cosmological term, a network of light strings, or fast-moving, light strings is studied in detail. The observational tests which can be used to discriminate between these models are also discussed. These tests include the magnitude-redshift, lookback time-redshift, angular size-redshift, and comoving volume-redshift diagrams and the growth of density fluctuations. 58 references.

38076 **New estimate of the mixing length and convective overshooting in massive stars.** Cloutman, L.D. (Los Alamos National Lab., NM). *Astrophysical Journal;* **313**: 699-710(Feb 1987).

A new approach to estimating the length scale of turbulent motions in convection zones of stars is presented. It is based on a statistical model of turbulence specialized to the stellar interior. It is predicted that the length scale of turbulence is proportional to the turbulence Mach number and to the geometric mean of the pressure scale height and a length scale associated with variations in the strength of the buoyancy forces. This model is applied to a 15.57 solar mass star, and it predicts strong overshooting in a layer up to several solar masses thick outside the convective core. It produces significant increases in the core hydrogen-burning lifetime and in the luminosity after core hydrogen exhaustion, and it removes the conditions that produce semiconvection. 28 references.

38077 **Gamma-ray constraint on the nature of dark matter.** Silk, J.; Bloemen, H. (California Univ., Berkeley). *Astrophysical Journal;* **313**: L47-L51(Feb 1987).

If even a small component of the Galactic spheroid consists of the weakly interacting majorana fermions that are cold-dark-matter candidate particles for the Galactic halo, there should be a substantial flux of annihilation gamma rays from a source of about 1-deg extent at the Galactic center. COS B observations already constrain the halo cold-dark-matter (CDM) content entrained in the inner spheroid to be less than about 10 percent. A somewhat weaker constraint applies to the CDM believed to be present in the Galactic disk, but still only about 15 percent can be in such particles. Monochromatic line photons of energy 3-10 GeV are also predicted, and future experiments may be capable of improving these limits. Since both theoretical models of galaxy formation in a CDM-dominated universe and mass models for the rotation curve in the inner Galaxy suggest that a substantial fraction of the spheroid component should be nonluminous and incorporate entrained halo CDM, the hypothesis that the halo CDM consists predominantly of weakly interacting fermions such as photinos or heavy majorana mass neutrinos or higgsinos may already be subject to observational test. 30 references.

38078 **Baryon and lepton number violation in astrophysics.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL). pp 969-976 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The cosmological and astrophysical significance of baryon and lepton number violating process is the subject of this talk. The possibility of baryon-number violating processes in the electroweak transition in the early universe is reviewed. The implications of lepton-number violation via Nambu-Goldstone bosons are discussed in detail. 555 figures.

38079 **Weak interaction and the large scale structure of the universe.** Schramm, D.N. (Chicago Univ., IL; Fermi National Accelerator Lab., Batavia, IL). pp 1032-1044 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—). Contract FG02-85ER40234.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The combined problems of large scale structure, the need for non-baryonic dark matter if $\Omega=1$, and the need to make galaxies early in the history of the universe seem to be placing severe constraints on cosmological models. In addition, it is shown that the bulk of the baryonic matter is also dark and must be accounted for as well. The nucleosynthesis arguments are now strongly supported by high energy collider experiments as well as astronomical abundance data. The arguments for dark matter are reviewed and it is shown that observational dynamical arguments and nucleosynthesis are all still consistent at $\Omega$proportional to 0.1. However, the inflation paradigm requires $\Omega=1$, thus, the need for non-baryonic dark matter. A non-zero cosmological constant is argued to be an inappropriate solution. Dark matter candidates fall into two categories, hot (neutrino-like) and cold (axion or massive photino-like). New observations of large scale structure in the universe (voids, foam, and large scale velocity fields) seem to be most easily understood if the dominant matter of the universe is in the form of low mass (9 eV $\leqq$ m/sub $\nu$/ $\leqq$ 35 eV) neutrinos. 555 figures.

## 6402 Atmospheric Physics

*REFER ALSO TO CITATION(S) 38055, 38059, 38065, 38098, 38350*

**38080 (AD-A—179059/1/XAB) Middle atmosphere density and models. Technical report.** Champion, K. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 9 Apr 1987. 9p. (AFGL-TR—87-0116). NTIS, PC A02/MF A01.

The 80 to 130 km altitude region is our old ionosphere - the region of the atmosphere that no one seems to be interested in, and yet the critical region for shuttle entry and atmospheric braking. Comparison between the Air Force reference atmosphere and Shuttle IMU data shows large fluctuations at high latitudes. New data sources are available now, such as the Arecibo and Millstone Hill ionospheric scatter radars.

**38081 (AD-A—179136/7/XAB) Generation of broadband noise in the magnetotail.** Dusenbery, P.B.; Lyons, L.R. (Aerospace Corp., El Segundo, CA (USA). Laboratory Operations). 1 Mar 1987. 29p. (TR—0086(6940-06)-12). NTIS, PC A03/MF A01.

Generation of electrostatic noise in the geomagnetic tail by ion beams was evaluated. A stationary plasma-sheet electron distribution and streaming ion distributions were assumed. Both warm-ion streams, as observed within the plasma-sheet boundary layer, and cold-ion streams, as expected from upward-flowing ionospheric ions, are considered. Warm-ion streams by themselves are found to be stable, whereas a cold-ion stream by itself is unstable to the beam-acoustic model. However, wave growth is increased if both cold and warm streams are simultaneously present. These results suggest that the interaction between the warm- and cold-ion streams is responsible for the peak in electrostatic-wave intensities observed within the plasma-sheet boundary layer. For cold and warm ions streaming in the same direction, wave growth peaks for wave normal angles theta = $O^{o}$ and wave frequencies about 0.1 x the electron plasma frequency were found. However, for anti-parallel streaming cold and warm ions, wave growth peaks near theta approx. = $90^{o}$ and wave frequencies are an order of magnitude smaller. Including counter-streaming warm ions in addition to a cold-ion stream results in wave growth that is a superposition of that for the above two cases.

**38082 (AD-A—179174/8/XAB) Preliminary investigation of ionospheric modifucation using oblique-incidence high-power h-f (high-frequency) radio waves. Technical report.** Sales, G.S.; Reinisch, B.W.; Dozois, C.G. (Lowell Univ., MA (USA). Center for Atmospheric Research). Sep 1986. 44p. (ULRF—435/CAR). NTIS, PC A03/MF A01.

A special experiment was carried out using a high-powered transmitter and a high-gain rhombic antenna to heat the ionosphere at a distance of 1300 km from the transmitter. A Digisonde ionospheric sounder was located at the midpoint to sense any changes that might occur in the ionosphere at the heating cycle period of ten minutes. The measured phase data were processed using spectrum analysis in an attempt to detect this ten-minute period. The results are not conclusive, but there is some indication that the heating period was detected only during the nighttime in agreement with theoretical prediction.

**38083 (AD-A—179184/7/XAB) Magnetosphere-ionosphere interaction studies. Final report, 11 July 1980-30 June 1984.** Doyle, S.M.; Anderson, P.; Basinska-Lewin, E.; Rich, F.; Young, E.R. (Regis Coll., Weston, MA (USA)). 30 Jun 1984. 103p. NTIS, PC A06/MF A01.

The objectives of this contract were twofold: 1) study of the electrodynamics of the ionosphere-magnetosphere system in order to gain new insight about the transmission of energy and particles through the system using data from the S3-2, S3-3 and DMSP satellites; 2) design, test, and evaluate new spacecraft hardware for measuring particles and fields more efficiently and completely. This report summarizes five studies performed in fulfillment of objective 1. The accomplishment of objective 2 has involved the design of instrumentation for several satellite programs and is detailed in Section 2 of the report. The final section describes software developed for preliminary processing of data from the retarding potential analyzer, yielding estimates of typical plasma parameters.

**38084 (AD-A—179224/1/XAB) Correlation between asymptotic directions of cosmic-ray particles and cutoff rigidities in the evolving geomagnetic field.** Flueckiger, E.O.; Smart, D.F.; Shea, M.A.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Mar 1987. 5p. (AFGL-TR—87-0120). NTIS, PC A02/MF A01.

Pub. in J. of Geophysical Research, Vol. 92, No. A3, 2551-2554(1 Mar 1987).

The concept of geomagnetic optics, as described by the asymptotic directions of approach, is extremely useful in the analysis of cosmic radiation data. However, when changes in cutoff rigidities occur as a result of evolution in the geomagnetic field, there are corresponding changes in the asymptotic cones of acceptance. It has been demonstrated that the effect of geomagnetic disturbances on asymptotic directions of approach can be estimated for nonpolar locations from the corresponding change in the cutoff rigidity. In this paper it is shown that the same procedure is applicable with respect to the secular evolution in the geomagnetic field, and that, with this procedure, it is possible to adjust reference published asymptotic directions to other epochs if the change in cutoff rigidity is known.

**38085 (AD-A—179258/9/XAB) Atmospheric radiance profile codes. Technical report.** Yap, B.K. (Utah State Univ., Logan (USA). Center for Space Engineering). 17 Sep 1986. 52p. (CSE—86-120). NTIS, PC A04/MF A01.

This report presents and describes the computer codes developed to generate atmospheric radiance profiles for various molecules, species, and rotational bands. Researchers extracted radiance profiles from the standard NLTE program output files and transferred them from the Cyber system to the Apollo system. Efforts include a routine to plot the radiance profiles sum total and SPIRE program measured data.

**38086 (AD-A—179374/4/XAB) Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986.** Schunk, R.W. (Utah State Univ., Logan (USA). Center for Atmospheric and Space Sciences). 14 Jan 1987. 11p. NTIS, PC A02/MF A01.

MITHRAS is a coordinated multiradar program to study the interactions between the magnetosphere, ionosphere, and thermosphere, as well as the phenomena that result from these interactions. The program is based on a data set acquired by the Chatanika, Millstone Hill, and Eiscat incoherent scatter radars. A large portion of the data is unique in that it was the only time when the radars, well separated in local and magnetic time, simultaneously probed the high latitude ionosphere. The concern was model data comparisons, specifically, the author compared the predictions of his three-dimensional, time-dependent model of the high-latitude ionosphere with MITHRAS data sets. Of particular interest were the variations of the ionosphere with altitude, latitude, longitude, universal time, season, and magnetic activity. Model data comparisons enabled determination of the adequacy of current understanding of high-latitude ionosphere dynamics as well as certain magnetosphere/ionosphere/atmosphere coupling processes.

**38087 (N—87-21427) Retarding potential analyzer research. Semiannual report, 1 July-31 December 1986.** Hanson, W.B. (Texas Univ., Dallas (USA)). Apr 1987. 9p. (NASA-CR—180508; NAS—1.26:180508). NTIS, PC A02/MF A01.

Studies were continued in the areas of ionospheric electrodynamics, plasma irregularities, and ion-neutral coupling. The spectral characteristics of structure in the ion concentration and the electric field at high latitudes were examined. It was found that in the region of velocity shears the relationship between the slopes of the two spectra are dependent on the existence of large field-aligned currents and apparently large ionospheric conductivity gradients. The relationship between the Joule dissipation and the locally measured value of the ion temperature were studied by examining the horizontal ion drift velocity. The importance of ion-neutral coupling was investigated in additional studies involving the nature of the coupling at high latitude boundaries and during times of magnetic disturbances. Much of this behavior can be modeled using

globular circulation models. In order to study the storm time response of the thermosphere the global ion convection pattern was derived from DE-2 measurements and used as input in a circulation model. The calculated variables of neutral velocity and composition and temperature were compared with measurements to validate the technique.

## 6403 Atomic, Molecular, And Chemical Physics

*REFER ALSO TO CITATION(S) 37388, 37409, 37432, 37474, 38320, 38324*

38088 **(AD-A—179066/6/XAB) Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985.** Crasemann, B. (Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Angewandte Botanik). 15 Feb 1985. 20p. NTIS, PC A02/MF A01.

Deep atomic-hole states constitute a regime that has only recently become amenable to detailed investigation. The physics of atomic inner shells are peculiar in several respects: (i) Transitions are mostly radiationless, proceed through many channels, and are often very strong; hole state lifetimes thus become as short as attoseconds, with widths measured in tens of electron volts. The dynamics of inner-shell transitions consequently exhibit unusual features. This research program has explored these peculiar properties of energetic inner-shell processes. Attention was paid to relativistic and quantum-electrodynamic effects and large-scale state-of-the-art computations of hole-state energies, and transition rates were made. In the course of this work, the first general computer code for the relativistic calculation of Auger rates was developed.

38089 **(AD-A—179137/5/XAB) Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987.** Crasemann, B. (Oregon Univ., Eugene (USA). Dept. of Physics). 15 Jan 1987. 12p. NTIS, PC A02/MF A01.

Experimental and theoretical research on atomic inner-shell physics was performed. Relativistic calculations of energy levels and transition rates were performed, including configuration interaction and quantum-electrodynamic effects. Cross sections for inner-shell ionization by slow protons were computed relativistically. The dynamics of inner-shell processes has been studied through experiments with radiation. Based on resonant-scattering theory, a unified theory was developed that describes resonant Raman processes at threshold, post-collision interaction above threshold, and the traditional two-step excitation-deexcitation model in the high-energy limit. A study of multiphoton multiionization in strong laser fields was initiated.

38090 **(AD-A—179154/0/XAB) Low-energy collisions of excited atoms. Final report, 1 May 1984-30 April 1985.** Neynaber, R.H. (La Jolla Inst., CA (USA)). 29 May 1985. 5p. NTIS, PC A02/MF A01.

Alkali-halogen and alkali-alkali systems were studied, including sodium-bromine, Na-chlorine, Na-Na, and Na*-Na. All atoms were in the ground state except Na*, which represents Na in the first electronic state. Merging-beams techniques were used for the former systems and beam-gas for the latter. Laser radiation was employed to generate Na* either in the beam or the gas. Theoretical predictions of cross sections for Na-Br and Na-Cl have been made by Faist and Levine and are in good agreement with these experimental results. Comparisons of cress sections for Na-Na and Na* show that electronic excitation of Na greatly enhances ion-pair production.

38091 **(AD-A—179226/6/XAB) Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987.** Lam, J.F.; McFarlane, R.A.; Palmer, A.J.; Steel, D.G.; Turley, R.S. (Hughes Research Labs., Malibu, CA (USA)). 31 Jan 1987. 130p. (HAC-REF-E—9915). NTIS, PC A07/MF A01.

Experimental and theoretical studies are made of issues relevant to laser cooling and emittance control of neutral beams. Experimental accomplishments include development of a technique for state specific velocity selection in atomic beams, observation of the optical Kapitza Dirac Effect, construction of sodium and atomic hydrogen beam facilities, and initial development of a tunable, transform-limited, vacuum-ultraviolet source. Theoretical accomplishments include development of a theory of pi pulse cooling, a theory of two-photon ionization in atomic hydrogen resonant with the Lyman-alpha transition, and an incorporation of the effects of intense fields in the theory of the Optical Kapitza Dirac Effect.

38092 **(AD-A—179390/0/XAB) Frequency-shift measurements of the Q(1) and Q(2) lines of $H_2$ using high-resolution c-w Coherent Anti-Stokes Raman Spectroscopy. Master's thesis, June-October 1986.** Jelonek, M.P. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). 10 Dec 1986. 55p. (AFIT/GEP/ENP—86D-5). NTIS, PC A04/MF A01.

Linear and quadratic frequency shift coefficients were determined for the Q(1) and Q(2) lines of hydrogen using cw Coherent Anti-Stokes Raman Spectroscopy (CARS). The linear coefficients were accurate to three significant digits which is an order of magnitude better than any other published results. The quadratic coefficients were comparable to other reported results because of the range of pressures investigated in this study. Frequency stabilization of the argon-ion laser allowed accurate measurements of the frequency shifts over a range of 2 to 40 atmospheres. A Fabry-Perot interferometer provides a relative-frequency marker and iodine absorption peaks provided an absolute-frequency reference. The coefficients determined were compared to those calculated by other researchers using different experimental methods. The high accuracy of the measurements added further credence to the effectiveness of cw CARS as a high-resolution spectroscopic tool.

38093 **(AD-A—179585/5/XAB) Master-equation approach to collisionally induced absorption and emission.** Alber, G.; Cooper, J. (Colorado Univ., Boulder (USA)). May 1986. 32p. NTIS, PC A03/MF A01.

Pub. in Physical Review A, Vol. 33, No. 5, 3084-3112(May 1986).

The collisionally induced excitation and photon emission of a neutral radiator atom surrounded by a gas of netural foreign perturbers is studied within the binary-collision approximation. An equation of motion is derived for the reduced density matrix of the radiator and the spectrum is obtained of the spontaneously emitted photons includng components due to collisionally induced radiation and to Rayleigh scattering, which is valid in both impact and quasistatic regimes. In the formulation single and subsequent collisional contributions are taken into account, and various coherent and incoherent corrections are examined.

38094 **(CONF-870752—1-Ext.Abst.) The evaporative vector: Homogeneous systems.** Klots, C.E. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009812.

From 11. international symposium on molecular beams; Edinburgh, UK (12 Jul 1987).

Molecular beams of van der Waals molecules are the subject of much current research. Among the methods used to form these beams, three-sputtering, laser ablation, and the sonic nozzle expansion of neat gases - yield what are now recognized to be "warm clusters." They contain enough internal energy to undergo a number of first-order processes, in particular that of evaporation. Because of this evaporation and its attendant cooling, the properties of such clusters are time-dependent. The states of matter which can be arrived at via an evaporative vector on a typical laboratory time-scale are discussed. Topics include the (1) temperatures, (2) metastability, (3) phase transitions, (4) kinetic energies of fragmentation, and (5) the expression of magical properties, all for evaporating homogeneous clusters.

38095 **(GSI—86-55-Prepr.) Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u.** Tsertos, H.; Bosch, F.; Kienle, P.; Koenig, W.; Kozhuharov, C.; Berdermann, E.; Huchler, S.; Wagner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Dec 1986. 7p. NTIS, PC E07; Available from NTIS as TIB/B87-04531.

High resolution positron spectroscopy in U-U collisions at bombarding energies of 5.6 MeV/u, the lowest energy studied until now as well as of 5.9 MeV/u, reveals similar multiple structures between 220 keV and 385 keV superimposed on the induced and nuclear continua.

38096 **(LBL—23307) Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams.** Page, R.H. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 324p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87012093.

The absorption spectrum of water dimers in the O-H stretching region (~3400 to 3800 $cm^{-1}$) was obtained by monitoring vibrational predissociation. The O-H stretching frequencies of the dimer were shifted by hydrogen bonding. In a lower-resolution experiment, $(H_2O)_{19}$ clusters were studied. The effect of the cluster temperature on the absorption spectrum was discussed. Rotationally resolved photoionization spectra of $H_2O$ and $D_2O$ were obtained. Energies of some excited states were accurately determined. Autoionizing Rydberg series in the spectra were identified. XUV-UV and XUV-visible double-resonance experiments on $H_2$ are described. Two infrared-ultraviolet double resonance experiments on benzene were performed. This provided evidence that showed that the C-H stretching admixture contains four states instead of three. A reassignment of the benzene uv spectrum is suggested. A Fermi resonance in the excited state was also detected.

38097 **State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$.** Shao, J.D. Ames, IA; Iowa State Univ. (1986). 166p. University Microfilms Order No. 87-03,768.Contract W-7405-ENG-82.

Thesis (Ph. D).

A new ion-molecule reaction apparatus, which consists of a photoionization source, a tandem mass spectrometer, and a radio frequency (rf) octopole reaction cell, is described. Using a quadrupole mass filter to reject $H_3^+$ background ions formed at the photoionization region, absolute total cross sections for the reaction $H_3^+(nu_0') + H_2(nu_0'' = 0) \rightarrow H_3^+ + H$, were measured as a function of the vibrational state of reactant $H_3^+$, where $nu_0' = 0$-4, over the center-of-mass collision energy range of 0.04-15eV. Absolute spin-orbit-state-selected total cross sections for charge transfer reactions $Ar^+(^2P/sub\ 3/2/) + N_2X, v = 0)$ and $Ar^+(^2P/sub\ 1/2/) + N_2 X, v = 0)$, $\sigma/sub\ 3/2/$ and $\sigma/sub\ 1/2/$, respectively, at the E/sub c.m./ range of 0.25-115.3 eV were also measured using the same apparatus. With the triple-quadrupole double-octopole photoionization tandem mass spectrometer, absolute state-selected total cross sections, $\sigma/sub\ v'/,v' = 0$ and 1, for reaction $N_2^+(X, v' = 0,1) + Ar(^1S_0) \rightarrow N_2(X,v) + Ar^+(^2P/sub\ 3/2,1/2/)$ (reaction (1)) over E/sub c.m./ range of 1.2-140 eV were measured.

## 6404 Fluid Physics

*REFER ALSO TO CITATION(S) 38311, 38319*

38098 **(AD-A—179144/1/XAB) NRL (Naval Research Laboratory) plasma formulary, (revised).** Book, D.L. (Naval Research Lab., Washington, DC (USA)). 1987. 61p. NTIS, PC A04/MF A01.

Supersedes AD—A135-787, dated 1983.

Contents include: numerical and alegbraic; vector identities; differential operations in curvilinear coordinates; dimensional systems (SSI) nomenclature; metric prefixes, physical constants (cgs); formula conversion. Maxwell's equations; electricity and magnetism; electromagnetic frequency/wavelength bands; a-c circuits; dimensionless numbers of fluid mechanics; shocks; fundamental plasma parameters; plasma-dispersion function; collisions and transport; approximate magnitudes in some typical plasmas; ionospheric parameters; solar-physics parameters; thermonumclear fusion; relativistic electron beams; beam instabilities; lasers; atomic physics and radiation.

38099 **(AD-A—179209/2/XAB) Effects of corona on heat transfer in an enclosure. Master's thesis.** Dyer, D.D. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 79p. (AFIT/GA/AA—86D-4). NTIS, PC A05/MF A01.

Experiments were conducted to determine the effects of corona wind on heat-transfer rates for enclosures. Tests were performed with an enclosed cavity heated on the bottom and cooled on the top (and vice versa). A corona wind was established inside the cavity by applying high voltages to 0.004-inch-diameter chromel wires placed along the hot and cold surfaces of the cavity. Tests were conducted using both positive voltage potential and negative voltage potential to create the corona discharge. Different wiring configurations were used to establish a variety of flow patterns inside the cavity. The heated-surface heat-transfer rates were calculated for each of the test configurations with and without corona. These heat-transfer rates were determined when the corona discharge was present and compared to the rates found when the discharge was not present. Comparing these transfer rates revealed how much the corona wind augmented the heat-transfer process. Results showed corona wind can increase heat transfer rates inside an enclosure by almost four times the rates attained without the corona discharge for the wire configurations investigated.

38100 **(AD-A—179212/6/XAB) Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis.** DelGrande, J.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 83p. (AFIT/GEP/ENP—86D-3). NTIS, PC A05/MF A01.

This thesis develops the foundation for an experiment to determine the radial distribution of the negative atomic oxygen ion in the positive column of a plasma discharge. Lee's theory is modified to apply to a discharge of square cross section. A new design for a discharge tube is presented. The operating characteristics of this tube are investigated: current-voltage measurements are made showing operating regimes of the T-form and H-form of the discharge, and acoustic waves are shown to exist in the T-form region. Three experimental designs are presented to determine the radial density of the oxygen anion, each involving photodetachment.

38101 **(DOE/ER/10807—03) [Some basic research problems related to energy: Progress report].** Cohen, E.G.D. (Rockefeller Univ., New York (USA)). 1987. Contract AC02-81ER10807. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011018.

Brief descriptions are given for three research areas: transport properties of multicomponent fluid mixtures, fluctuations in a Rayleigh-Benard cell, and light and neutron scattering of simple fluids. (WRF)

38102 **(DOE/ER/25014—1) SIAM 1986 national meeting: Final technical report.** (Society for Industrial and Applied Mathematics, Philadelphia, PA (USA)). 22 Sep 1986. Contract FG02-86ER25014. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011015.

A summary of the meeting is given. Included are lists of the invited speakers, special lectures, and the minisymposia. (WRF)

38103 **(LBL—23342) Numerical solution of the Hele-Shaw equations.** Whitaker, N. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011211.

An algorithm is presented for approximating the motion of the interface between two immiscible fluids in a Hele-Shaw cell. The interface is represented by a set of volume fractions. We use the Simple Line Interface Calculation method along with the

method of fractional steps to transport the interface. The equation of continuity leads to a Poisson equation for the pressure. The Poisson equation is discretized. Near the interface where the velocity field is discontinuous, the discretization is based on a weak formulation of the continuity equation. Interpolation is used on each side of the interface to increase the accuracy of the algorithm. The weak formulation as well as the interpolation are based on the computed volume fractions. This treatment of the interface is new. The discretized equations are solved by a modified conjugate gradient method. Surface tension is included and the curvature is computed through the use of osculating circles. For perturbations of small amplitude, a surprisingly good agreement is found between the numerical results and linearized perturbation theory. Numerical results are presented for the finite amplitude growth of unstable fingers. 62 refs., 13 figs.

38104 **(UCRL—96763) Numerical solutions for laminar flow over a backward-facing step.** Szymczak, W.G.; Solomon, J.M.; Berger, A.E.; Bell, J.B.; Osborn, J.E. (Naval Surface Weapons Center, Silver Spring, MD (USA); Lawrence Livermore National Lab., CA (USA); Maryland Univ., College Park (USA). Dept. of Mathematics). Jun 1987. Contract W-7405-ENG-48. 10p. (CONF-870677—7). NTIS, PC A02. File Number DE87010782.

From 6. IMACS international symposium on computer methods for partial differential equations; Bethlehem, PA, USA (23 Jun 1987).

In this paper, we present numerical results for steady two-dimensional laminar flow over a rearward facing step. This problem is special in the sense that the use of conservative central differencing of the convective terms does not generate spurious oscillations in the flowfield, even when the cell Reynolds number condition is violated. However, spurious oscillations do appear when considering either the problem of flow over a full step or flow in a smoothly expanding channel. A scheme in which artificial viscosity is added primarily in the flow direction is shown to be more stable than the central difference scheme, without the loss of accuracy associated with certain first order upwind schemes. These computational results are compared to the experimental measurements of Armaly et al., on the rearward facing step problem. The accuracy of these schemes as well as several others appearing in the literature are also tested on two model convection diffusion problems.

38105 **Analytic theory for the linear stability of the Saffman—Taylor finger.** Tanveer, S. (Department of Applied Mathematics, California Institute of Technology, Pasadena, California 91125). *Physics of Fluids;* **30**: No. 8, 2318-2329(Aug 1987).

An analytic theory is presented for the linear stability of the Saffman—Taylor finger in a Hele—Shaw cell. Eigenvalues of the stability operator are determined in the limit of zero surface tension and it is found that all modes for the McLean—Saffman branch of solutions [J. Fluid Mech. 102, 455 (1980)] are neutrally stable, whereas other branches first calculated by Romero (Ph.D. thesis, California Institute of Technology, 1982) and Vanden-Broeck [Phys. Fluids 26, 2033 (1983)] are unstable to arbitrary infinitesimal disturbances. It is also shown that the Saffman—Taylor discrete set of eigenvalues is a special case of a continuous unstable spectrum for zero surface tension. The introduction of any amount of surface tension perturbs the corresponding eigenmodes such that the finger boundary is a nonanalytic curve in general. Only transcendentally small terms in surface tension are responsible for the nonanalyticity of the finger boundary as in the case of Saffman—Taylor steady finger solutions of arbitrary finger width.

38106 **Alignment of vorticity and scalar gradient with strain rate in simulated Navier—Stokes turbulence.** Ashurst, W.T.; Kerstein, A.R.; Kerr, R.M.; Gibson, C.H. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Physics of Fluids;* **30**: No. 8, 2343-2353(Aug 1987).

The alignment between vorticity and eigenvectors of the strain-rate tensor in numerical solutions of Navier—Stokes turbulence is studied. Solutions for isotropic flow and homogeneous shear flow from pseudospectral calculations using $128^3$ grid points have been examined. The Taylor Reynolds number is 83 or greater. In both flows there is an increased probability for the vorticity to point in the intermediate strain direction and at three-fourths of the sample points this strain is positive (extensive). This propensity for vorticity alignment with a positive intermediate strain is a consequence of angular momentum conservation, as shown by a restricted Euler model of the coupling between strain and vorticity. Probability distributions for intermediate strain, conditioned on total strain, change from a symmetric triangular form at small strain to an asymmetric one for large strain. The most probable value of the asymmetric distribution gives strains in the ratios of 3:1: -4. The evolution of the distribution from a symmetric to an asymmetric form as the strain magnitude increases is essentially the same in both flows, indicating a generic structure of intense turbulence. The alignment between the gradient of a passive scalar and eigenvectors of the strain-rate tensor for Prandtl numbers of 0.1, 0.2, 0.5, and 1.0 has also been studied. There is an increased probability for the scalar gradient to align in the most compressive strain direction, and the average gradient is larger when it is pointing in that direction. Estimates for the scalar dissipation from the turbulent kinetic energy, its dissipation, and the root-mean-square scalar value are in reasonable agreement with calculated scalar dissipation if no explicit Prandtl number dependence is used in the estimate.

38107 **Modeling the viscous wall region.** Azab, K.A.; McLaughlin, J.B. (Department of Physics, Clarkson University, Potsdam, New York 13676). *Physics of Fluids;* **30**: No. 8, 2362-2373(Aug 1987).

A model is used to study the viscous wall region of turbulent shear flowsover rigid flat surfaces. Periodic boundary conditions are imposed in thehorizontal directions with periodicity lengths that are several times largerthan the experimental streak spacing. In order to sustain the turbulence in theviscous wall region, the averaged x component of the velocity is set equal to a fixed profile outside the viscous wall region. Pseudospectral methods are used to solve the governing equations with the Marcus time splitting scheme. It is shown that a model of the viscous wall region can reproduce much of the behavior seen in direct simulations of turbulence that place greater demands on computer resources. The model is used to investigate the flow of energy in the viscous wall region and the relationship between low-speed streaks and vortices in the viscous wall region.

38108 **Interpretation of the Yakhot—Orszag turbulence theory.** Kraichnan, R.H. (303 Potrillo Drive, Los Alamos, New Mexico 87544). *Physics of Fluids;* **30**: No. 8, 2400-2405(Aug 1987).

Yakhot and Orszag have recently developed a theory of turbulence [J. Sci. Comput. 1, 3 (1986)] based on dynamic renormalization-group (RNG) techniques. They predict parameters of the Kolmogorov inertial range and then successfully use eddy-viscosity formulas from the inertial-range theory in computations of shear flows. In the present paper a critical analysis of the Yakhot—Orszag theory is offered based on comparison with a simple perturbative model. The latter appears to parallel much of the physical and operational content of the lowest order of the Yakhot—Orszag theory, without using RNG methods. The essence is as follows: (1) the dynamics of modes in the inertial and dissipation ranges are assumed to be dominated by interactions more-or-less local in wavenumber that are modeled by a white-noise force acting against an effective viscosity; and (2) the effective viscosity is estimated by extrapolation from the small contributions of interactions very nonlocal in wavenumber (distant interactions). In common with the Yakhot—Orszag theory, the only explicit contacts with the Navier—Stokes equation are overall energy conservation by nonlinear terms and the interaction coefficients of highly nonlocal wave vector triads.

## 6450 High Energy Physics

*REFER ALSO TO CITATION(S) 37187, 38232*

38109 **(SLAC—312, pp 285-308) Aspects of computing in high energy physics.** Kunz, P.F. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A variety of network services are being provided for High Energy Physics with a variety of network protocols. This diversity reflects the diversity of opinion of what are the most important perceived needs. This diversity is also influenced by the style of computing for a particular collaboration. For example, a collaboration based on centralized computing, typically the mainframe computer at the national laboratory, puts emphasis on remote logon and remote printing, while one that is based on distributed computing puts emphasis on file transfer and process to process communications. In both styles and for communications outside the collaboration, electronic mail and file transfer are important. The major networks in use by HEP are BITNET, PHYSNET, X.15 based networks, Data switches/terminal multiplexors, and MFENET. Note that there is very little development of networking software or hardware being done by HEP. All of the above are implemented with off-the-shelf items that can be bought from various vendors or available from other sources.

## 6451 Particle Interactions And Properties - Experimental

*REFER ALSO TO CITATION(S) 37535, 37539, 37574, 37575, 38209, 38221, 38236, 38243, 38249, 38250, 38259*

38110 **(ANL-HEP-CP—87-31) Recent results on polarizations and the present status of the Fermilab polarized beams.** Yokosawa, Akihiko. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 21p. (CONF-8609296—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011405.

From Workshop on spin phenomena in hadronic interactions; Wuppertal, F.R. Germany (15 Sep 1986).

Experimental results are reviewed on polarization phenomena in nucleon-nucleon scattering at intermediate energies. The present status of S = 0 dibaryon resonances is presented. The status of the Fermilab polarized beam program is presented, including the construction of polarized beam, two polarimeters being installed in the experimental hall, and the experimental program. (LEW)

38111 **(ANL-HEP-CP—87-49) Evidence for the decay tau$^-$ → $\pi^-$eta nu/sub tau/.** Repond, J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. (CONF-870278—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011541.

From 4. family of quarks and leptons international symposium; Santa Monica, CA, USA (26 Feb 1987).

The inclusive production of eta mesons in tau lepton decay has been studied using the High Resolution Spectrometer at the PEP $e^+e^-$ facility. The data sample corresponds to an integrated luminosity of 300 $pb^{-1}$ and the storage ring was operated at $\sqrt{s}$ = 29 GeV. The eta production appears to be only compatible with the decay tau$^-$ → $\pi^-$eta nu, which violates isospin and G-parity conservation. The branching ratio of 5.1 +- 1.5% explains much of the current discrepancy between the one-prong topological branching ratio and the sum of the individual one-prong modes. Various checks to test the validity of the signal are described.

38112 **(BNL—39657) Electroweak radiative corrections and neutral current phenomenology.** Marciano, W.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 11p. (CONF-870121—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010050.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

Precision measurements of sin$^2$ θ/sub W/ including the effects of radiative corrections are surveyed. A world average sin$^2$ θ/sub W/ = 0.231 +- 0.004 is obtained. Comparison of deep-inelastic nu/sub μ/N scattering and m/sub W/ or m/sub Z/ is shown to test the standard model at the quantum loop level and constrain new physics. Implications for extra Z' bosons and grand unified theories are briefly discussed. 25 refs., 2 figs.

38113 **(BNL—39661) Review of the Brookhaven neutrino workshop.** Murtagh, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 32p. (CONF-870279—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010071.

From Lake Louise winter institute; Alberta, Canada (15 Feb 1987).

Recent experimental results on searches at accelerators for nu/sub μ/ → nu/sub e/ oscillations presented at the Brookhaven National Laboratory Neutrino Workshop are reviewed and prospects for extending these searches are discussed.

38114 **(BNL—39663) ν/sub μ/e → ν/sub μ/e and ν/sub μ/p → ν/sub μ/p.** Suzuki, Y. (Brookhaven National Lab., Upton, NY (USA); Osaka Univ. (Japan)). 1986. Contract AC02-76CH00016. 12p. (CONF-8606201—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010042.

From Neutrino '86; Sendai, Japan (3 Jun 1986).

Recent results on the neutrino electron and the neutrino proton elastic scattering from Exp. 734 at BNL are presented. The values of the sin$^2$Θ/sub w/ from the measurements are in good agreement.

38115 **(BNL—39665) Elastic scattering of muon neutrinos at BNL.** Abe, K.; Ahrens, L.A.; Amako, K.; Aronson, S.H.; Beier, E.W.; Callas, J.L.; Cutts, D.; Diwan, M.; Durkin, L.S.; Gibbard, B.G. (Brookhaven National Lab., Upton, NY (USA); Brown Univ., Providence, RI (USA). Dept. of Physics; Hiroshima Univ. (Japan). Dept. of Physics; National Lab. for High Energy Physics, Oho, Ibaraki (Japan); Osaka Univ., Toyonaka (Japan). Dept. of Physics; Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Feb 1987. Contract AC02-76CH00016. 8p. (BNL—39662; CONF-870283—7; CONF-870121—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010069.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

In this paper measurement of the purely leptonic reactions: nu/sub μ/e → nu/sub μ/e and anti nu/sub μ/e → anti nu/sub μ/e, and the semileptonic reactions: nu/sub μ/p → nu/sub μ/p and anti nu/sub μ/p → anti nu/sub μ/p are presented and discussed in terms of the standard model. The data also places limites of interest on the magnitudes of a possible neutrino charge radius and a neutrino magnetic moment.

38116 **(DESY—86-012) Excited lepton search.** Behrend, H.J.; Buerger, J.; Criegee, L.; Fenner, H.; Field, J.H.; Franke, G.; Fuster, J.; Holler, Y.; Meyer, J.; Schroeder, V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Glasgow Univ. (UK); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.); Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). Feb 1986. 21p. (LAL—85/50). NTIS, PC E07; Available from NTIS as TIB/B87-06444.

Using the CELLO detector at PETRA we have searched for excited leptons by studying e/sup +/e/sup -/ interactions which yield p/sup +/p/sup -/γγ, l/sup +/l/sup -/γ and γγ final states, where l = 3, μ or tau. We observe good agreement with QED and set new limits on e*, μ*, and tau* production.

38117 **(DESY—86-023) Radiative tau pair production and search for new particles decaying into tau.** Bartel, W.; Becker, L.; Felst, R.; Haidt, D.; Knies, G.; Krehbiel, H.; Laurikainen, P.; Magnussen, N.; Meinke, R.; Naroska, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik; Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.; Lancaster Univ. (UK); Manchester Univ. (UK); Maryland Univ., College Park (USA)). Feb 1986. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-06441.

A study of radiative tau pair production, e/sup +/e/sup -/ -> tau/sup +/tau/sup -/γ and e/sup +/e/sup -/ -> tau/sup +/

tau/sup -/$\gamma\gamma$, is presented. The observed events agree with QED predictions of order $\alpha$/sup 3/ and $\alpha$/sup 4/. Excited tau's have been searched for and lower limits on single and pair production are obtained. For QED-like coupling the tau* mass is limited to values greater than 40 GeV (95% CL). A search for unstable charged scalars (S/sup +-/) decaying into tau, e.g. charged Higgs, technipions or the supersymmetric partners of tau's, yields no evidence for such particles. Assuming a branching fraction of B(S -> tau$\nu$) = 1, S masses up to 18.7 GeV are excluded with 95% CL.

38118 **(DOE/ER/03130—35) A research program in experimental high energy physics: Task C, Progress report for contract period January 1, 1987 to December 31, 1987.** Lanou, R.E. Jr.; Cutts, D. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Jul 1987. Contract AC02-76ER03130. 90p. (COO—3130TC-35). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012066.

An experimental program in strong and electro-weak interaction physics of elementary particles is being carried out using electronic detection techniques. Experiments have been performed at Brown, Brookhaven, Fermilab and SLAC. The work described in this report by the Electronic Detector Group addresses the following: (1) electroweak parameters via neutrino interactions, (2) preparations for experiments ("D-ZERO") at the FNAL 2 TeV anti pp Collider, (3) neutrino properties, and (4) study of the charm system.

38119 **(DOE/ER/03130—262) Inclusive charged and neutral pion photoproduction at 20 GeV.** Rickman O'Dell, V. (Brown Univ., Providence, RI (USA). Dept. of Physics). May 1987. Contract AC02-76ER03130. 180p. (COO—3130TB-262). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87011621.

The inclusive charged and neutral pion distributions from the interactions of 20 GeV photons on protons have been measured. The assumptions and analysis done to obtain these distributions are described, and the pion distributions are found to agree with general predictions of the quark-parton model. The quark-quark fusion model and the recombination model were compared to the inclusive pion distributions assuming the photon could be approximated by a superposition of rho and omega vector meson states - an assumption prompted by the Vector Meson Dominance Model of photon structure. Quark models applied to the difference in the charged pion cross sections are examined. The inclusive charge structure of the photoproduced charged pions and that of electroproduced and hadroproduced charged pions were compared. (LEW)

38120 **(DOE/ER/03130—264) A research program in experimental high energy physics: Task B, Progress report for contract period January 1, 1987 to December 31, 1987.** Widgoff, M. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Jul 1987. Contract AC02-76ER03130. 77p. (COO—3130TB-264). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012065.

The group at Brown has joined a collaboration to carry out experiments in high energy physics using astrophysical sources, in the new underground laboratory being prepared at Gran Sasso. We are building a detector (LVD) which includes a large volume of liquid scintillator together with a multilayered omnidirectional tracking system of high spatial and angular resolution, in order to study particle physics in a domain beyond the range of accelerators now or soon to be available. Among the physics questions we will be able to address very effectively are neutrino oscillations, discrete sources of high energy radiation including muons and neutrinos, dark matter and exotic particles, neutrinos from stellar collapse, and monopoles. During the past year, analysis has continued on the data of SLAC experiments BC72/73/75, studying the interactions in hydrogen of 20 GeV polarized photons. Inclusive $\gamma$p interactions are being studied in detail in this high statistics sample. The hybrid detector built by the Tau Neutrino Collaboration, with the Tohoku one-meter holographic freon bubble chamber as target, has a successful first run at the Tevatron (E745), and data obtained on muon neutrino interactions at high energies are being analyzed. The system has been upgraded for a second run in the Tevatron muon neutrino beam during the summer and fall of 1987. Meanwhile, analysis of data on some aspects of interactions of hadrons with protons and heavier nuclei is continuing (Fermilab E565, E570, E299, E154). Monte Carlo studies of various calorimeter designs have been carried out, with a view to finding ways to employ absorber materials other than uranium effectively, by making use of a software technique to substitute for the compensating effect of uranium. The technique has been found to be useful in improving the energy resolution obtainable with Pb or Cu absorbers.

38121 **(DOE/ER/05096—26) High energy physics: Progress report.** Phillips, G.C.; Roberts, J.B. Jr.; Bonner, B.E. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 31 May 1987. Contract AS05-76ER05096. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011207.

Analysis of data on collision of protons with targets of He, Be, C, Al, Sn, and Pb continued. A jet signal has been clearly observed from all nuclei. A collaboration has been formed for carrying out an experiment studying the photoproduced jets from nuclei and propagation of quarks and gluons through nuclear matter. The production of lambda hyperons was studied using the primary polarized beam at BNL/AGS at 13.3 and 18.5 GeV/c. The effect of the proton beam polarization on the lambda production, A/sub N/ and spin transfer have been measured. A request was approved for additional polarized proton beam at the AGS to continue measurements of the spin transfer to hyperons. Progress is reported on an initial 200 GeV/c polarized beam-polarized target experiment. A collaborative experiment was approved for the saearch for exotic/hybrid mesons. Investigations in quantum field theories, especially quantum chromodynamics, were contined. (LEW)

38122 **(DOE/ER/10699—T6) Experimental high energy physics using electromagnetic energy calorimetry: [Progress report].** Marx, M.D. (State Univ. of New York, Stony Brook (USA). Research Foundation). [1987]. Contract AC02-80ER10699. 60p. NTIS, PC A04. File Number DE87011868.

Progress is reported on two areas of contribution to the DO project - construction of the central drift chamber and its electronics and test facilities, and development of the central and end cap modules, test beam program, and software development for the calorimetry. Work is also reported in the area of neutrino physics, in which an experiment has measured cross sections for neutral current processes which are used to determine the Weinberg angle, as well as the axial-vector dipole mass of the proton. Limits were also placed on the electromagnetic properties of the muon neutrino, namely its charge radius and magnetic moment. Limits have also been placed on neutrino oscillations and couplings to heavy neutrinos. (LEW)

38123 **(DOE/ER/40107—T3) Experimental investigations of production of glueballs and meson resonant states.** Lindenbaum, S.J. (City Coll., New York (USA); City Univ. of New York, NY (USA). Research Foundation). 1987. Contract AC02-83ER40107. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010794.

The major efforts reported have been directed toward investigating glueballs and non-strange mesons. The g/sub T/(2050), g/sub T'/(2300), and g/sub T"/(2350) have been observed in the OZI forbidden reaction $\pi^- p \rightarrow$ phi phi n. Their characteristics are explained within the context of quantum chromodynamics as being produced by 1 to 3 primary glueballs. It is proposed to increase the present statistics in order to reduce the effective partial wave analysis resolution, and to begin to study the high vertical bar t' vertical bar region. It is further planned to pursue coupled channel analysis of high precision $\pi^- p \rightarrow$ K/sub s/$^0$K/sub s/$^0$n data and other relevant world data in the $2^{++}$, $0^{++}$, and $4^{++}$ channels. A program is planned to investigate $K^- p$ and p anti p interactions at 8 GeV/c. (LEW)

**38124 (DOE/ER/40150—25) Spin degrees of freedom in electron nucleon scattering in the resonance region.** Burkert, V.D. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1987. Contract AC05-84ER40150. 8p. (CEBAF-PR—87-006; CONF-870165—3). NTIS, PC A02. File Number DE87008667.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

Some aspects of using polarized electrons and/or polarized targets in electron-nucleon scattering experiments are discussed. Polarization measurements can be used to extend the knowledge of nucleon form-factor measurements to higher $Q^2$ and are indispensable for a model-independent extraction of the helicity amplitudes of exclusive meson production. Measurements of polarization asymmetries may also help in revealing the excitation of weaker resonances.

**38125 (FNAL/C—87/71) Study of charm production mechanisms at the Fermilab Tagged Photon Spectrometer: γBe yields D anti D x and γA yields psi x.** Nash, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 9p. (CONF-870339—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010082.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

This paper describes recent work on charm photoproduction mechanisms based on data from Experiment 691 at the Fermilab Tagged Photon Spectrometer. Preliminary results on open charm production in the energy range 80 to 190 GeV are reported based on a preliminary analysis of 3000 charm events, comprising 30% of the data sample. These results include fits to P perpendicular and X/sub F/ distributions, a measurement of the total charm production cross section on Be and its increase with energy from 100 to 200 GeV, as well as a measurement of the relative fraction of anti D, D, and D* production. Also reported is data based on a special closed geometry run to study the A dependence of psi photoproduction. For the first time in a single experiment, relative cross sections on H, Be, Fe and Pb for both the coherent and incoherent components of the signal have been measured with reduced systematic errors and these results are reported here.

**38126 (FNAL/C—87/82) Experimental results on heavy flavour hadro- and photo-production.** Purohit, M.V. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 12p. (CONF-870334—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011067.

From Workshop on results and perspectives in particle physics; La Thuile, Italy (1 Mar 1987).

Results from experiments on the production of beauty and charm with hadron and photon beams are reviewed. Beauty production experiments are beginning to obtain b anti b cross-sections with hadron beams. Hadroproduction of charm is a somewhat more mature field, although high statistics are still eagerly sought. The situation is most promising with charm photoproduction experiments where total cross-sections, p/sub T/$^2$ and X/sub F/ distributions and other production characteristics are now known in considerable detail.

**38127 (SLAC—312, pp 33-48) CP and other experimental probes of electroweak phenomena.** Winstein, B. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

In these lectures some topics where probes of electroweak phenomena are likely either to confirm the Standard Model or point to phenomena which lie beyond it are treated. The current status on the measurement of important parameters of the model, limits on the existence of other phenomena beyond it, and the important measurements of the charged current couplings are discussed. A more extensive treatment of CP nonconservation in the $K^0$ system and the prospects for improvement there are given. The signatures for CP nonconservation in the heavy quark systems will be discussed. Finally, the various searches for phenomena beyond the Standard Model in the study of rare or forbidden decays, particularly of the K meson are reviewed.

**38128 (SLAC—312, pp 49-52) Bound on the number of neutrinos from $e^+e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA.** Lavine, T.L. (Univ. of Wisconsin, Madison). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Searches for single unaccompanied photons in $e^+e^-$ collisions at PEP and PETRA are combined. The upper limit on the single-photon process $e^+e^- \rightarrow \gamma$ upsilon anti upsilon is used to obtain a bound on the number of light-neutrinos.

**38129 (SLAC—312, pp 191-222) Phenomenology of heavy quark systems.** Gilman, F.J. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A brief and incomplete review of the spectroscopy of heavy quark systems is given. A good qualitative picture of the nature of the spin-independent forces exists. That, plus some phenomenological potentials inspired by fundamental theory, carry us a long way. For the spin-dependent effects there is even a semi-quantitative understanding, as they are more sensitive to the short distance part of the potential and there is more insight and more tools to help sort things out. Eventually, a quantitative calculation of both the spin-independent potential $V(\gamma)$ and the spin-dependent potentials $V_2(\gamma)$, $V_3(\gamma)$, and $V_4(\gamma)$, is sought from QCD. This will likely come in due time from improvements in computer power and in technique over the present lattice calculations. In the meantime, to clarify the emerging picture, more data is needed on: the $^1P_1$ states of charmonium and bottomonium, the eta b, the other D/sup **,/s, and the spectrum of toponium.

**38130 (SLAC—312, pp 239-284) Heavy quark spectroscopy and decay.** Schindler, R.H. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The extensive exclusive measurements of $D^0$ and $D^+$ mesons provide a reasonably firm basis for understanding the charm meson width. The decays of $D^0$ and $D^+$ appear to have a large quasi two-body component. There is evidence for color-suppressed decays, decays in which interference is occurring, and decays where flavor-annihilation appears to be present. Studies of the semileptonic decays point to hadronic matrix elements that are relatively simple, being dominated by form factors that are well modelled by simple poles. Detailed information on the D/sub s/, meson is still lacking. The latter would provide the most direct means of checking the current ideas on interference, flavor-annihilation and the apparent dominance of quasi two-body decays of charm. An alternative is to measure the factors that make up the theoretical estimate of the rate for each of these processes. While D/sub s/ → tau nu should provide an experimentally accessible measurement of the weak decay constant f/sub D./, stringent limits on f/sub D/ from D → μ nu already provide information on the size of perturbative effects that may allow flavor-annihilation to proceed at a measurable rate. The decays of light B mesons (B/sub u/ and B/sub d/) appears to be dominated as expected by the b → c transition. The determination of the b → u fraction has been clouded both by theoretical uncertainties and by experimental difficulty. The lack of a global picture for B hadronic decay has also been hampered by the lack of data on exclusive channels. Inclusive studies of B → D/sub s/, PSI, and D project a spectator-like picture. The smallness of the semileptonic branching ratio however leads one to believe that the nonleptonic sector of B decay may yet hold some surprises. The key to understanding B decay will be in the ability to separate the species B/sub u/ and B/sub d/ and to systematically study the exclusive decays.

**38131 (SLAC—312, pp 361-386) Recent results from the UA1 experiment at CERN.** Dobrzynski, L. (College de France, Paris). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Results based on a sample of events with large missing transverse energy corresponding to 715 $nb^{-1}$ of data from the UA1 experiment at the CERN anti pp Collider are presented. High transverse momentum tau-leptons from W decays are observed for the first time through their semi-hadronic decay modes. The first direct tests of the e - $\mu$ - tau universality of the weak charged couplings at $Q^2$ = M/sub w/$^2$ is provided. Measured W and $Z^0$ rates and heavy flavor cross sections are used to predict rates of missing transverse energy events from all known Standard Model processes, and thereby to place limits on possible new sources. After taking into account all known sources of missing energy events, they find a mass limit on a fourth generation charged lepton of m/sub L/ > 41 GeV/$c^2$ (90% C.L.) and a limit on the number of additional neutrinos of N/sub $\nu$/ < 7 (90% C.L.). Lower limits for supersymmetric particles, namely 60 GeV/$c^2$ for the gluino and 70 GeV/$c^2$ for the squark (90% C.L.) are also given. Finally, two events are presented in which two energetic hadronic jets and a high energy lepton are balanced by missing energy. These events are discussed and compared to all observed W + 2-jet events.

38132 (SLAC—312, pp 387-414) **Latest results from the UA2 experiment.** Plothow-Besch, H. Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A study has been made of the decays W → ev and Z → $e^+e^-$, using the UA2 detector at the CERN anti pp Collider. The data correspond to an integrated luminosity of 142 $nb^{-1}$ at a center of mass collision energy $\sqrt{s}$ = 546 GeV, and 768 $nb^{-1}$ at $\sqrt{s}$ = 630 GeV. Measurements of the Standard Model parameters from samples of 251 W decay and 39 Z decay candidates are compared with expectations of the Standard Electroweak Model. Jet cross sections are presented and compared with the predictions of QCD and with data at lower energies. An exclusive sample of three-jet events is analyzed and compared with a phase-space model and with QCD. The strong coupling constant a/sub s/ s measured. An exclusive four-jet data sample is used to test perturbative QCD to order a/sub $s^4$ and to search for the existence of collisions in which more than one hard scattering among partons takes place. A status report is given on the search for the decay of the Intermediate Vector Bosons W and Z into a quark-antiquark pair.

38133 (SLAC—312, pp 415-430) **Results on theta/sub w/ from the CERN high-energy neutrino experiments or: why theta/sub w/? How theta/sub w/?.** Barbiellini, G. (CERN, Geneva, Switzerland). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Neutrino-nucleon experiments performed with the CDHS and the CHARM detectors at the CERN SPS are reported. The experimental setup is discussed and data presented. Extraction of the Weinberg angle is from the data is discussed and compared to other methods of calculation.

38134 (SLAC—312, pp 431-454) **Physics from PEP.** Ford, W.T. (Univ. of Colorado, Boulder). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—). Contract AC02-86ER40253.

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Recent results from PEP experiments are reviewed. Included are searches for SUSY particles and measurement of the number of neutrino flavors, two-photon production of resonances pertinent to glueball spectroscopy, tau lepton decays, QCD and electroweak tests, and heavy quark lifetimes.

38135 (SLAC—312, pp 455-474) **Results from PETRA.** Barlow, R. (Manchester Univ., England). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A review of results from several PETRA experiments performed over the past year is presented. Results cover electroweak asymmetries, low thrust events with isolated muons, lifetime measurements for D, F and B mesons, charm production and QCD related studies. Inclusive muon production and heavy quark fragmentation are also discussed.

38136 (SLAC—312, pp 475-494) **Recent results from ARGUS.** Yoon, T. (Univ. of Toronto, Ontario). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The ARGUS experiment, running at the DORIS II storage ring, has been collecting data on e+e- collisions near 10 GeV region since the end of 1982. The ARGUS detector, designed specifically for large acceptance and high resolution spectroscopy in the UPSILON resonances region, has produced a prolific amount of new results in recent months. Some of these are presented here. The subject matters include topics from charm and beauty spectroscopy and weak decays of charm mesons, beauty mesons and the tauon.

38137 (SLAC—312, pp 507-524) **Recent results on upsilon physics from CUSB-II.** Tuts, P.M. (Columbia Univ., New York, NY). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

New results on Upsilon(3S) spectroscopy and new particle searches have been obtained using CUSB-II, a high resolution bismuth germanate electromagnetic spectrometer. No evidence is seen for long lived axions, light neutral Higg's, or gluinos in radiative Upsilon decays. Confidence level upper limits on their branching ratios are presented, together with the excluded gluino mass range. The branching fraction of the Upsilon(3S) into muons, B/sub $\mu\mu$/(3S), was measured to be (1.53 +/- 0.29 +/- 0.21)%, the Upsilon(3S) total width to be 25.5 +/- 5.0 keV, $\alpha$/sub s/ = 0.17 +/- 0.014 and $\Lambda$/sub MS/ = 148 +/- 50 MeV. By observing the Upsilon(3S) → chi/sub b/(2P) $\gamma$ → (Upsilon(2S), Upsilon(2S))$\gamma\gamma$ → ell ell $\gamma\gamma$ decay chain they resolved completely the J=2 and J=1 chi/sub b/(2P) states. They obtain product ratios for the decay chains and derive the hadronic widths of the chi/sub b/(2P) states. They also resolved the J=O state in the inclusive photon spectrum and measured the fine structure of the chi/sub b/(2P) state.

38138 (SLAC—312, pp 525-536) **Recent results from the crystal ball experiment.** Lowe, S.T. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

This report reviews several recent analyses from the Crystal Ball collaboration. The major topics discussed are the search for new states in radiative Upsilon(1S) decays, the search for lepton number-violating and inclusive eta decay modes of the tau, and results from $\gamma\gamma$ physics.

38139 (SLAC—312, pp 537-568) **J/psi spectroscopy from MARK III.** Mallik, U. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The MARK III detector at the SPEAR $e^+e^-$ storage ring at SLAC has accumulated a data sample of 5.8 x $10^6$ J/psi produced. The status of the zeta(2230) observed in the radiative J/psi decay is described. The status of the glueball candidates eta(1440) (iota(1440)) and $f_2$(1720) (theta(1720)) are probed with a systematic comparison between the radiative and the hadronic decays of J/psi. Finally, an understanding of quark correlations is attempted from a systematic study of the J/psi decaying into Vector-Pseudoscalar, Vector-Tensor and Vector-Scalar nonets.

38140 (SLAC—312, pp 569-596) **New results on mesons containing strange quarks.** Ratcliff, B.N. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Recent results on strange and strangeonium mesons are presented. The data come from a high sensitivity study (4.1 ev/nb) of $K^-$ p interactions at 11 GeV/c using the LASS spectrometer at SLAC. The complete leading orbitally-excited K* series up through J/sup P/ = $5^-$ and a substantial number of the expected underlying states are observed decaying into $K^- \pi^+$, anti K°/sub s/ $\pi^+\pi^-$, and K eta final states, and new measurements are made of their masses, widths, and branching ratios. Production of strangeonium states via hypercharge exchange is observed into K/sub s/°K/sub s/°, $K^-K^+$, and K/sub s/°K/sup +/-/ $\pi$/sup +/-/ final states. The leading orbitally-excited phi series through J/sup P/ = $3^-$ is clearly seen and evidence is presented for additional high spin structure in the 2.2 GeV/c² region. No $f_2$(1720) is observed. The K/sub s/°K/sup +/-/$\pi$/sup +/-/ spectrum is dominated by $1^+$(K* anti K + anti K* K) production in the region below 1.6 GeV/c². These results are compared with data on the same systems produced by different production mechanisms.

38141 (SLAC—312, pp 597-606) **Charm hadroproduction in pp interactions at 400 GeV/c and 800 GeV/c.** Touboul, M.C. (CERN, Geneva, Switzerland). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Results for D meson production at two different facilities are presented and compared. Experiment NA27 was performed by exposing LEBC with the EHS to the 400 GeV/c proton beam at CERN SPS. Experiment E743 was done with the 800 GeV/c proton beam at Fermilab also using LEBC with the Fermilab Multiparticle Spectrometer. Differential cross sections for D production as a function of various parameters are presented and compared to predictions of the QCD fusion model.

38142 (SLAC—312, pp 633-642) **Recent axion searches.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The properties of axions are briefly reviewed and the basic experimental method used to search for them is outlined. The method involves the observation of electron bremsstrahlung or Primakoff radiation in beam dumps. Several recent experiments at Fermilab, KEK, SLAC and Orsay are reviewed and limiting values for axion lifetime and mass are given.

38143 (SLAC—312, pp 667-674) **CP violation in K-short decay.** Thomson, G.B. (Rutgers, The State Univ. of New Jersey, Piscataway). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The authors are performing an experiment at Fermilab (E621) to measure n/sub +-O/, the parameter describing CP violation in the decay K/sub s/° $\rightarrow \pi^+\pi^-\pi^0$. By collecting $\pi^+\pi^-\pi^0$ decays in a short neutral beam, they search for CP violation in the interference between K/sub S/° and K/sub L/° decays. They took data with the kaon beams produced from two targets, separated by 3 K/sub S/° lifetimes for the average momentum kaon. By comparing the proper time dependence of the data from the two targets they are able to extract an upper limit on eta/sub +-O that is independent of the acceptance of their detector. That upper limit is: absolute value of eta/sub +-O = .022 +/- .026, arg(eta/sub +-O/) = 39° +/- 80°, based on 86,000 events. They have collected an additional 3,200,000 events in a later run, which they are now analyzing, and they expect ultimately to achieve a sensitivity of $\sigma$ absolute value eta/sub +-O/ = .003.

38144 (SLAC—312, pp 675-686) **CERN neutral kaon CP violation experiment NA31.** Cundy, D.C. (European Organization for Nuclear Research, Geneva, Switzerland). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

An experiment to measure the CP violation parameter from decays in the neutral kaon system which is underway at CERN SPS is described. Methods for improving sensitivity and precision and correcting for background radiation are emphasized. Preliminary results from a separate experiment to measure neutral kaon radiative decay are also presented.

38145 (SLAC-PUB—3928) **Future frontiers for $e^+e^-$ collisions: physics of SLC and LEP.** Dorfan, J.M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 32p. (CONF-860292—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010843.

From Lake Louise winter institute in particle physics; Edmonton, Alberta, Canada (16 Feb 1986).

A brief historical review is given of the contribution to particle physics of $e^+e^-$ interactions, followed by a discussion of the LEP and SLC machines and the reasons for developing linear colliders. A brief overview of the Standard Model and some essential formalism for the process $e^+e^- \rightarrow$ f anti f are presented, followed by a discussion of detectors. Tests of the Standard Model and physics beyond the Standard Model that can be made running at the $Z^0$ are considered. LEP physics at energies above the $Z^0$ is discussed. (LEW)

38146 (SLAC-PUB—4287) **Experimental tests of quantum chromodynamics.** Dorfan, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 68p. (CONF-860736—16). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010547.

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Experimental tests of quantum chromodynamics are discussed in the $e^+e^-$ continuum, in pp and anti p p collisions, in measurements of $\alpha$/sub s/ from Y decays, in deep inelastic lepton scattering, and in the measurement of the photon structure function. A large body of data relating to the testing of quantum chromodynamics is reviewed, showing qualitative agreement between the data from a wide range of processes and QCD. 66 refs., 79 figs. (LEW)

38147 (SLAC-PUB—4300) **Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look.** Bigi, I.I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 7p. (CONF-870170—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009893.

From Workshop on a linear-collider B anti B factory; Los Angeles, CA, USA (26 Jan 1987).

Recent findings from UA1 and ARGUS on $B^0$ - anti $B^0$ mixing brighten considerably the prospects of findings CP violation in $B^0$ decays. We sketch some semi-quantitative scenarios where we also address technical issues like the amount of time that is necessary. We point out that searching for the reaction $\Upsilon(4s) \rightarrow B^0$ anti $B^0 \rightarrow f_1, f_2$, (where f/sub x/ = line integral), where $f_1$, $f_2$ are CP eigenstates of the same CP parity has a good chance of revealing CP violation. The tight upper bound on $D^0$ - anti $D^0$ mixing, namely 0.5-1%, still allows for CP asymmetries of up to 5% in (-) $D^0 \rightarrow K^+K^-$, K/sub s/$K^+K^-$.

38148 (SLAC-PUB—4312) **An upper limit on the decay $D^0 \rightarrow \mu e$.** Stockhausen, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 4p. (CONF-870390—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011591.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

A search for the lepton family number violating decay $D^0 \rightarrow \mu e$ is reported. No signal is observed in a data sample of 9.3 $pb^{-1}$ collected at the psi(3770) resonance with the Mark III detector, where 0.18 +- 0.06 +- 0.05 background events are expected. A

90% confidence level upper limit on the branching fraction B($D^0 \to \mu e$) of 1.5 x $10^{-4}$ is obtained.

38149 **(SLAC-PUB—4313) The decay tau → rho nu (and rho → π eta nu?).** Stockhausen, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 5p. (CONF-870390—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011592.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Motivated by the question of missing exclusive branching fractions in tau decays, mostly suspected to be in one prong decays with neutrals, we have studied the decay tau → rho nu in tau pair production by $e^+e^-$ annihilation at $\sqrt{s}$ = 3.77 GeV. The branching fraction is measured to be B(tau → rho nu) = (23.0 +- 1.3 +- 1.7)% consistent with known measurements and not offering a solution to the branching ratio question. No eta signal in the γγ mass spectrum pointing to a decay tau → eta π nu is obvious. An upper limit on this branching fraction is given.

38150 **Comparison of narrow-band and wide-band neutrino beams in the search for ν/sub μ/→ν/sub e/ oscillations.** Ahrens, L.A.; Aronson, S.H.; Gibbard, B.G.; Murtagh, M.J.; White, D.H.; Callas, J.L.; Cutts, D.; Hoftun, J.S.; Diwan, M.; Lanou, R.E.; and others. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 3, 702-706(1 Aug 1987).

Motivated by the apparent advantages of a narrow-band neutrino beam for neutrino-oscillation experiments, a search for ν/sub μ/→ν/sub e/ was made with a magnetic horn-focused 3-GeV narrow-band neutrino beam. The detector and its distance from the neutrino source were the same as in a previous search for ν/sub μ/→ν/sub e/ with a horn-focused wide-band neutrino beam of mean energy 1.2 GeV. A direct comparison of the results of the two searches is made, and a brief survey of events induced by a 1.3-GeV narrow-band neutrino beam is noted.

38151 **Measurement of the ratio of Σ0 to $\Lambda^0$ inclusive production from 28.5-GeV/c protons on beryllium.** Sullivan, M.W.; Jensen, D.A.; Kreisler, M.N.; Marcin, M.; Raychaudhuri, K.K.; Bunce, G.M.; Makdisi, Y.; Yamin, P.; Dukes, E.C.; Overseth, O.E.; and others. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01003). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 3, 674-689(1 Aug 1987).

The ratio of the cross section for $\Sigma^0$ inclusive production to the cross section for $\Lambda^0$ inclusive production has been measured with 28.5-GeV/c protons incident on a beryllium target at an average laboratory production angle of 4°. This ratio was measured to be 0.278 +- 0.011 +- 0.05, where the uncertainties are statistical and systematic in that order. The ratio does not depend strongly on the momentum of the produced particle between 10 and 24 GeV/c. The effect of $\Sigma^0$ contamination on previous determinations of the polarization of inclusively produced $\Lambda^0$'s is discussed.

38152 **Limit on the anti ν mass in free molecular tritium beta decay.** Bowles, T.J.; Wilkerson, J.F.; Browne, J.C.; Maley, M.P.; Robertson, R.G.H.; Knapp, D.A.; Helffrich, J.A. (Los Alamos National Lab., NM; Princeton Univ., NJ; California Univ., San Diego, La Jolla). pp 782-785 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

38153 **Search for short-lived axions emitted from neutron capture on protons.** Freedman, S.J.; Arnold, M.; Doehner, J.; Last, J.; Dubbers, D. (Argonne National Lab., IL; Heidelberg Univ., Germany, F.R.; Institut Max von Laue - Paul Langevin, 38 - Grenoble, France). pp 871-874 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—). Contract W-31-109-ENG-38.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

We have searched for a light neutral particle like the axion, which decays rapidly to positron-electron pairs, produced in the reaction n+p -> D+a. Instead of axions we found the $e^+e^-$ signal expected from direct internal pair conversion. A preliminary analysis gives (Γ/sub p//Γ/sub γ/)/sub expt//(Γ/sub p//Γ/sub γ/)/sub cal/ = 1.06+-0.12, for the measured to expected pair decay branching ratio. These results exclude existing axion models over the mass range 2 m/sub e/<m/sub a/<2.22 MeV/$c^2$. The axion mass would fall in this range if the axion was the explanation for the narrow positron lines observed in recent heavy-ion experiments at the GSI. 555 figures.

38154 **Search for gluonic bound states in high energy proton-proton collisions.** Isenhower, L.D. Ames, IA; Iowa State Univ. (1986). 180p. University Microfilms Order No. 87-03,717.Contract W-7405-ENG-82.

Thesis (Ph. D.).

The Double Pomeron Exchange process is studied as a potential source for the production of gluonic bound states utilizing the intersecting Storage Rings at the European Organization for Nuclear Research in Geneva, Switzerland. Three different triggers are studied, which differ in the requirements placed on the slow central system produced by the Pomeron-Pomeron interaction. Exclusive four and six prong events are studied. A spin-parity analysis is performed on the $\pi^+\pi^-$ system in the exclusive channel pp → pp$\pi^+\pi^-$ for two of the triggers. The exclusive process pp → ppK/sub S/$^0$K /sup +/-/ π/sup +/-/ is also studied and the $K^0K\pi$ mass spectrum is examined. An enhancement is seen in the region of 1500 MeV, but it appears to originate from events which have missing tracks, rather than from the exclusive final state. While this does not preclude its interpretation as a genuine resonant state, it does not mean that a definite statement cannot be made on the basis of this analysis.

## 6452 Particle Interactions And Properties - Theoretical

*REFER ALSO TO CITATION(S) 38069, 38130, 38221, 38265, 38272*

38155 **(BNL—39765) Monte Carlo determination of the spin-dependent potentials.** Campostrini, M.; Moriarty, K.J.M.; Rebbi, C. (Brookhaven National Lab., Upton, NY (USA); Istituto Nazionale di Fisica Nucleare, Pisa (Italy); Dalhousie Univ., Halifax, Nova Scotia (Canada); Boston Univ., MA (USA)). May 1987. Contract AC02-76CH00016. 8p. (CONF-8609142—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010760.

From Lattice gauge theory meeting; Upton, NY, USA (15 Sep 1986).

Calculation of the bound states of heavy quark systems by a Hamiltonian formulation based on an expansion of the interaction into inverse powers of the quark mass is discussed. The potentials for the spin-orbit and spin-spin coupling between quark and antiquark, which are responsible for the fine and hyperfine splittings in heavy quark spectroscopy, are expressed as expectation values of Wilson loop factors with suitable insertions of chromomagnetic or chromoelectric fields. A Monte Carlo simulation has been used to evaluate the expectation values and, from them, the spin-dependent potentials. The Monte Carlo calculation is reported to show a long-range, non-perturbative component in the interaction. (LEW)

38156 **(DESY—86-156) Strong CP problem and the visibility of invisible axions.** Buchmueller, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hannover Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Dec 1986. 31p. (ITP-UH—15/86; CONF-8609221—2). NTIS, PC E07; Available from NTIS as TIB/B87-07042.

From International school on low energy antiproton physics; Sicily, Italy (27 Sep 1986).

The main subject of these lectures are general properties of axions and recent suggestions of how to detect invisible axions. After a brief review of the strong CP problem and the Peccei-Quinn mechanism in sects. 2 and 3, we discuss axion properties by

means of an effective lagrangian approach in sect. 4. Experimental bounds on axion production and decays are reviewed in sect. 5. Sect. 6 deals briefly with the recently proposed variant axion models, and in sect. 7 we discuss the possible relevance of supersymmetry to the strong CP problem. In sect. 8 we then review the different proposals for the detection of invisible axions. Some conclusions are given in sect. 9. (orig./HSI).

**38157 (DOE/ER/02271—110) Theoretical high energy physics: Progress report for the period May 1, 1986-April 30, 1987.** Lee, T.D. (Columbia Univ., New York (USA). Dept. of Physics). May 1987. Contract AC02-76ER02271. 25p. (COO—2271-110). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010235.

Work is reported in the area of implementing QCD with dynamical fermions on a lattice parallel processor. Work on lattice gauge theory is reported, particularly the construction and use of high speed parallel computers for the Monte Carlo simulation of lattice quantum chromodynamics. Other work includes research on the long-range forces that arise from multi-photon exchange between diverse systems, and particle-antiparticle oscillations. Also reported is work on composite-Higgs models, composite fermion models, calculating corrections propagators in near-constant background fields, and calculating gluon scattering amplitudes using techniques derived from string theory. Soliton stars, black holes, and Hawking radiation were studied. An analytic expression was found for an inclusive two minijet cross section at collider energies in QCD. The very early stage of an ultra-relativistic heavy ion collision was studied. Research on glueball masses in QCD, the first Chern number of the normal bundle of work surface of a string, and computation of the rate of baryogenesis via processes involving homotopically nontrivial paths on configuration space is also reported. Problems arising from the application of high energy physics to the study of cosmology are also studied. (LEW)

**38158 (DOE/ER/03130—630) A research program in theoretical high-energy physics: Progress report.** Feldman, D.; Fried, H.M.; Jevicki, A.; Kang, Kyungsik; Tan, Chung-I. (Brown Univ., Providence, RI (USA). Dept. of Physics). 30 Jun 1987. Contract AC02-76ER03130. 39p. (COO—3130TA-630; BROWN/HET—630). NTIS, PC A03/MF A01; GPO Dep. File Number DE87012064.

Accomplishments are reported in the areas of string theory, nonperturbative analyses in quantum field theories, flavor gauge theory and grand unification theories, physics at the very early universe and quantum field theory, and critical phenomena in quantum field theory. (LEW)

**38159 (DOE/ER/03130—T13) Research program in computational physics: [Progress report for Task D].** Guralnik, G.S. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1987. Contract AC02-76ER03130. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011869.

Studies are reported of several aspects of the purely gluonic sector of QCD, including methods for efficiently generating gauge configurations, properties of the standard Wilson action and improved actions, and properties of the pure glue theory itself. Simulation of quantum chromodynamics in the "quenched approximation", in which the back reaction of quarks upon gauge fields is neglected, is studied with fermions introduced on the lattice via both Wilson and staggered formulations. Efforts are also reported to compute QCD matrix elements and to simulate QCD theory beyond the quenched approximation considering the effect of the quarks on the gauge fields. Work is in progress toward improving the algorithms used to generate the gauge field configurations and to compute the quark propagators. Implementation of lattice QCD on a hypercube is also reported. (LEW)

**38160 (DOE/ER/40073—T2) Theoretical high energy physics research at the University of Chicago: Technical progress report [for 1986].** Rosner, J.L. (Chicago Univ., IL (USA)). 1987. Contract AC02-82ER40073. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011217.

Research activities reported include: exotic fermions and gauge bosons in superstring models, collider physics, heavy quark spectroscopy, CP violation, color sextet quarks, neutral heavy leptons, fermion masses and supersymmetry, magnetic moments of baryons and other constraints on configuration mixing, dynamical mass generation, N = 2 supersymmetric QCD, and matrix methods in quantum mechanics. Other work addresses a fixed-target program and other non-SSC initiatives, hadroproduction of heavy quarks, electroproduction phenomenology at very small values of x, and spectrometer designs for the SSC. The novel physics possibilities of hadron colliders have been considered, and work is reported on radiative decays of the J/psi and on D-wave quarkonium levels, on the connection of elementary particles with cosmology and astrophysics, and conformal field theory. A rigorous development of the theory of super Riemann surfaces was developed with a view toward superstring applications. Work was pursued on supersymmetry breaking in the observable sector of superstring models and on inflationary cosmology. (LEW)

**38161 (DOE/ER/40150—12) Short range phenomena.** Chang, C.C.; Gross, F. (Maryland Univ., College Park (USA); Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 21p. (CEBAF-PR—86-007; CONF-8604194—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008662.

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

The theoretical approaches to treating quark degrees of freedom and relativistic effects in short range phenomena are summarized. One issue emphasized with regard to all the approaches discussed is the extent to which charge and current operators can be unambiguously determined from the underlying dynamics. If these operators are not constrained by the dynamics, then the electromagnetic experiments described would be expected to be less effective in giving direct information about the underlying physics. Recommendations for future work in the area are summarized. (LEW)

**38162 (DOE/ER/40158—3) The theory of high energy collision processes: Technical progress report, January 1, 1986 through December 31, 1986.** (Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). 15 Jan 1987. Contract FG02-84ER40158. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010682.

Progress is reported in these areas: detailed prediction of p anti p total and elastic differential cross sections at Tevatron of Fermilab; application of the method of helicity amplitudes to the gluon production of heavy quarkonium states; investigation of SU(2) lattice gauge theory in the limit of small coupling constants, with emphasis on the appearance of caustics; interpretation of sharp peaks in the positron spectrum from heavy nucleus collisions in terms of axions; analysis of the diagrammatic rules for finite-temperature field theory in Minkowski space; and quantum-mechanical calculation of bremsstrahlung. 14 refs. (LEW)

**38163 (DOE/ER/40200—091) Radiative B decays with four generations.** Hewett, J.L. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1987. Contract W-7405-ENG-82;FG05-85ER40200. 14p. (IS-J—2454). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010914.

We study the decay $b \to s\gamma$ in the four generation model including the effects of QCD corrections. We find the fourth generation contributions to be quite significant, extending the range of allowed branching ratios, $BR(b \to s\gamma)$, to lie both above and below the three generation standard model value. The existence of a fourth family of quarks would make a prediction for the top quark mass difficult to obtain from this process.

**38164 (DOE/ER/40200—092) Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories.** Hewett, J.L.; Rizzo, T.G. (Texas Univ., Austin (USA). Center for Particle Theory). Mar 1987. Contract W-7405-ENG-82;FG05-85ER40200. 29p. (IS-J—2469). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010915.

We examine the left-right and azimuthal polarization asymmetries of lepton pairs produced in $e^+e^-$ and $e^-e^-$ interactions as probes of new physics resulting from $E_6$ theories. The asymmetries are calculated and compared for the processes $e^+e^- \to \mu^+\mu^-$, $e^+e^-$

$\rightarrow e^+e^-$, $e^-e^- \rightarrow e^-e^-$, and $e^+e^- \rightarrow L^+L^-$ where L is either an $E_6$ exotic, mirror, or fourth generation heavy lepton. Our results show that lepton polarization asymmetries can be used to easily distinguish different $E_6$ models and can be used to distinguish among possible new heavy leptons L.

38165 (SLAC—306, pp 1-12) **Search for flavor-changing neutral currents at the $Z^0$.** Barbiellini, G.; Sadrozinski, H.F.W. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

In view of the hopefully large number of produced $Z^0$ in the coming years with the advent of SLC and LEP, the experimental possibility of an ideal detector to separate events from expected $Z^0$ decays into pairs of light and heavy quarks from the events from flavor changing neutral currents FCNC has been considered. Theoretical expectations for FCNC are very small in the standard model due to GIM cancellations, but could be larger ($\sim 10^{-4}$) with very heavy quarks in supersymmetric models or in case of a fourth generation. Furthermore, there are predictions that CP violation is maximal in such systems. In this work high efficiency algorithm is sought to separate on global jet parameters the such events.

38166 (SLAC—306, pp 23-39) **Physics from $Z^0$ measurements: mass, width, and total cross section.** Rankin, P. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This is an interim report on the activities of Working Group 1. The aim of this group is to enable as accurate a measurement as possible of the mass, width and total peak cross section of the $Z^0$ resonance to be made by the Mark II group at the SLC. Why we wish to do this is discussed in sections 2, how we can do it in sections 3 and 4. Section 3 deals with experimental limitations and sets the scale for how well we wish to control the theoretical uncertainties reviewed in section 4. Finally section 5 summarizes the problems to be resolved and our expectations.

38167 (SLAC—306, pp 40-44) **Renormalization of electroweak interactions and the BREMMUS Monte Carlo simulator.** Kennedy, D.C. II; Lynn, B.W. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This is a progress report on BREMMUS, the electroweak Monte Carlo simulation program originally developed for SLC/LEP physics by B.W. Lynn, R.G. Stuart, F.A. Berends, and R.H. Kleiss. The ultimate goal of BREMMUS development is a simulator that contains all of the numerically important contributions at SLC energies to the inclusive $e^+e^-$ light fermion production cross sections. This is an ambitious objective and, as such, requires a step-by-step approach in order to obtain reliable results.

38168 (SLAC—306, pp 45-65) **Study of QED radiative corrections at the Z.** Alexander J.; Bonvicini, G.; Drell, P.; Frey, R.; Milliken, B. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Precision tests of the electroweak theory in the Z region require a careful understanding of radiative corrections. The authors have been working to define clearly which theoretical results, analysis tools and cross checks are needed for such experiments. The authors will first describe the physics that is included in the event generator program MMG1 and will comment on the requirements for a generator suitable for the analysis of the MKII energy scan around the Z. Second, the authors will present results of an ongoing comparison between MMG1 and an exponentiation calculation from Bob Cahn. Third, the authors will discuss the event generator structure with particular emphasis on the fundamental numerical approximation inherent to this kind of generator. Fourth, the authors will present some results from this generator and its behavior in a narrow resonance region.

38169 (SLAC—306, pp 66-69) **Renormalization group improved Yennie-Frautschi-Suura Theory and Monte Carlo event generators.** Jadach, S.T.; Ward, B.F.L. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The authors describe the elements and the status of implementation of a procedure for incorporating renormalization group improved Yennie-Frautschi-Suura theory in an explicit algorithm for Monte Carlo event generation with an eye toward the high precision $Z^0$ physics at SLC and LEP.

38170 (SLAC—306, pp 89-99) **Status of Monte Carlos for a tau pair production at SLC.** Burchat, P. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The Monte Carlos for tau-pair production at the SLC, including spin effects and polarized beams, are in good shape. There are two quite independent, fairly complete Monte Carlos KORALZ and LUND/tau. The main limitation of both Monte Carlos at this point is the lack of higher multiplicity decay modes. The addition of these modes is in progress for both Monte Carlos. It is not necessary that all spin effects be included for these modes. The predictions of the two Monte Carlos are in agreement with each other and with theoretical predictions within statistical errors. More precise checks will be made with more statistics in the future.

38171 (SLAC—306, pp 100-113) **Report on electroweak parameters.** Matthews, J. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The measurements of the fundamental parameters of the Glashow-Salam-Weinberg model are one of the primary goals of the Mark II collaboration at the SLC. The plan for this note is as follows. Section II reviews the standard model assumptions and the present status of the world measurements of sin (theta-weak)**2. The Mark II measurements at the mass of the $Z^0$ are summarized in Section III; this section closes with a discussion of the luminosity requirements for the Mark II measurements of sin (theta-weak)**2. The author expectations for the Mark II/SLC tests of the Standard Model are summarized in Section IV.

38172 (SLAC—306, pp 114-127) **Forward-backward asymmetry for b and c quarks.** Wagner, S.; Smith, J.; White, S. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

In this paper we discuss methods used to measure heavy quark asymmetries at PEP and PETRA and their application to our future SLC data. The results given are from talks by Jim Smith at Asilomar and Steve Wagner at Granlibakken. The tagging of $e^+e^- \rightarrow Z^0 \rightarrow$ c ant c events is done with D/sup *+/ mesons selected with the Dm technique. This method has been tested with good results with the Mark II Upgrade PEP data. Since this analysis is already fully documented, a detailed description of the D/sup *+/ selection procedure and the associated plots is omitted from this paper. Studies of the familiar techniques of tagging $e^+e^- \rightarrow Z^0 \rightarrow$ b ant b events with high pt leptons are discussed. An alternative technique for measuring the b quark asymmetry with vertex tagging and the determination of the quark charge from the jet charge is also described. We estimate the expected statistical precision of the above measurements for a sample of $10^6$ $Z^0$ events collected with the Mark II detector at the SLC.

38173 (SLAC—306, pp 128-140) **Status report on the polarization facility at the SLC.** Moffeit, K.C. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The project to provide polarized electrons for SLC is now approved and work has begun. The author plant to have the systems installed by the end of the summer of 1988. A key test of

SLAC's resolve to meet this schedule will be placing the order for the superconducting solenoids by the end of 1986.

38174 (SLAC—306, pp 141-151) **Search for new interactions via lepton flavor violation at or beyond the $Z^0$ pole.** Heusch, C.A. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Looking for flavor-changing weak currents (FCNC) in the charged lepton sector is a natural task to be performed in $e^+e^-$ annihilation experiments. Stringent limits from rare decay experiments involving electrons and muons make the search for non-diagonal matrix elements containing a tau most promising. Signatures are reasonably straight-forward in the framework of the MARK II/ SLC Detector, with etau final-state sensitivities better by a factor 3 to 5 than μtau. This ratio may not be as sever for some of the LEP detectors. Assuming standard (minimal) $Q^2$-dependencies for new interactions, this search leads to sensitivities of their energy scale at a level of ~ 1 TeV (SLC) to ~ 12 TeV (LEP II). While we do not wish to tie this project up with a specific model, we note that many Standard Model extensions would permit the appearance of lepton-flavors non-diagonal terms at a level which cannot be predicted reliably; their experimental investigation is therefore all the more strongly indicated.

38175 (SLAC—306, pp 152-158) **Monte Carlo models for top production.** O'Shaughnessy, K. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This note describes some of the results that the Open Top Subgroup has obtained in the study of top production in QCD Monte Carlos. Section II recalls the conclusions reached at the Mark II Collaboration workshop at Asilomar in March, 1986. Section III describes top production in the current versions of the Monte Carlos that are available. In Section IV, several physical quantities predicted by the models are compared. Finally, Section V draws some conclusions about the ways the different models can be used for open top studies at SLC energies. We now have a variety of QCD Monte Carlos which produce t ant t events. These models fit the PEP data moderately well and are consistent in their predictions at SLC energies. However, some event parameters vary significantly from model to model, for example the aplanarity of the event. It is necessary to test top analysis programs on the different models to check the model independence of a given method. Ideally we would like to have several model-independent analysis methods which could be used to establish a top signal and determine the top mass.

38176 (SLAC—306, pp 159-188) **Finding open top.** Hanson, G. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This report summarizes the work of the Open Top Subgroup. Kathy O'Shaughnessy and Alfred Petersen have described the Monte Carlo models which we use for open top production and for non-top multihadronic background. In addition to investigating the models, our work can be divided into three topics: (1) establishing a top signal; (2) measuring the top mass; and (3) establishing that what we find is really top. The work on these topics will be discussed in the following sections.

38177 (SLAC—306, pp 189-211) **Supersymmetric particle searches.** Barklow, T. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Previous experimental results for the production of supersymmetric particles are briefly reviewed. The variables which can be used to isolate such events are then discussed and event simulation is described. Distinguishing events from background is considered.

38178 (SLAC—306, pp 212-219) **Small visible energy events and close-mass lepton pairs.** Perl, M.L. (Stanford Univ., CA). 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

In this paper, presented at the XXIII International Conference on High Energy Physics, recent reviews on the search for new leptons beyond the electron, muon, and tau generations are updated. An unexplored region in the mass ranges of leptons: small visible energy events in electron-positron annihilation and close-mass pairs is discussed.

38179 (SLAC—306, pp 220-253) **Toponium physics with a small data sample.** Porter, F. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The first data samples on toponium in $e^+e^-$ will naturally be rather small. In this note, the author will investigate what physics may be accessible with such a small dataset (of order 1k toponium decays). This is basically a summary of my talk at the Mark II workshop at Granlibakken, and is a report on work by the Mark II toponium working group. This group has concerned itself principally with two questions: (1) will the event rate at the SLC be sufficient to find toponium in a reasonable period of time, and what size event sample could the Mark II hope to achieve on toponium; and (2) given such a sample of events, what physics topics (if any) can be addressed.

38180 (SLAC—306, pp 254-273) **Reconstructing heavy long-lived neutral leptons.** Weinstein, A. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This report summarizes some work that has been done on reconstruction of heavy, long-lived neutral leptons (neutrinos). In the first section we review models of the production and decay of heavy neutrinos. We then discuss a Monte Carlo study to isolate and reconstruct the heavy neutrinos and measure their mass and lifetime. The discussion includes a digression on trigger and track reconstruction efficiency and resolution. Finally we review the work that remains for improving our algorithms and generalizing our search.

38181 (SLAC—306, pp 274-319) **New stable charged particles.** Banks, T.; Bartelt, J.; Boyarski, A.; Karliner, M.; Peck, C.; Soderstrom, E.; Stroynowski, R. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The subject of new stable charged particles encompasses a large range of possible topics. For the purpose of present discussion we have narrowed it down to the problems related to charged particles with lifetime longer than $10^{-10}$ sec, which would appear as tracks in the drift chamber of the Mark II. These include absolutely stable new particles with electrical charge +/- 1 as well as particles which may decay beyond the tracking volume of the detector. In addition, we address the problem of the detection of free quarks with charges 1/3 and 2/3 and discuss the procedure to detect Dirac type magnetic monopoles. The outline of this note is as follows: in Section 1, the theoretical expectations are summarized and most likely theoretical candidates for new stable particles are describes in some detail, Section 2 contains a discussion of the detection of massive long lived particles with charge 1, while Section 3 and 4 describe searches for free quarks and magnetic monopoles.

38182 (SLAC—306, pp 320-326) **Summary of work on $Z^0 \rightarrow$ Higgs neutrinos antineutrinos.** Wood, D. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

This document describes the status, as of the Granlibakken workshop, of the study of the search for $Z^0 \rightarrow$ Higgs neutrinos antineutrinos.

38183 (SLAC—306, pp 327-340) **Higgs boson production at the Z⁰ and the possibilities of vertex detectors.** Schwarz, A.S. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

The process $Z^0 \rightarrow Z^{0*}H^0$ is generally accepted to be the most promising production process of the standard model neutral Higgs boson in the vicinity of the $Z^0$ pole. up to now the general attention focussed mainly on the leptonic decay modes of the (virtual) $Z^0$ and here again mainly on the electron and muon final state. The advantage of this mode is clear: assuming even moderate electron and muon identification, the final state is spectactularly clean: two high energy leptons recoiling against the decay products of the Higgs boson. The recoil mass calculated from the momenta of the two leptons in addition would peak at the mass of the Higgs boson. However, despite its clean signature, the rates for this process are rather low (e.g. only 3.2-3.4% of the $Z^0$ decays proceed through $Z^0 \rightarrow u+u$-). So the natural conclusion is, to try to incorporate the other decaymodes of the $Z^0$ as well. The different decay modes of the $Z^0$ have been grouped into charged lepton pairs, neutrino pairs and quark pairs respectively, since these lead to distinctly different event topologies. The top quark has been assumed to be too heavy to be produced in the decays of the $Z^0$ decays and hence the top quark will not be discussed further. The event topology with the $Z^0$ decaying into electrons/muons has been discussed elsewhere and so this note will concentrate on those modes where $Z^0 \rightarrow$ nu anti nu and $Z^0 \rightarrow$ q anti q.

38184 (SLAC—306, pp 341-347) **Summary of work on $Z^0 \rightarrow$ Higgs anti ff.** Innes, W. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

To summarize the outlook for low mass Higgs searches, we expect 1-2 tagged events per $10^4$ Z decays for m/sub H/ $\leq$ 4 GeV/c². The identity of a few events will be ambiguous. A few tens of Higgs events will have characteristics which say, Higgs. The overall situation for Higgs searching is much the same as for low mass Higgs. Somewhat more then $10^5$ Z decays are required to before we can hope to observe Higgs mesons. To reach masses near 30 GeV/c² $10^6$ Z decays are needed. The only practical way observe masses much higher than this is through toponium decay (if toponium is below the Z).

38185 (SLAC—306, pp 348-351) **Summary of work on QCD backgrounds to $Z^0 \rightarrow H^0$ anti ell ell.** Weir, A. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

In the region M/sub Higgs/ > 5 GeV/c² the dominant background to the process $Z^0 \rightarrow H^0$ ell (where ell anti ell is either $e^+e^-$ or $\mu^+\mu^-$) comes from $Z^0 \rightarrow$ t and t events in which both quarks decay semi-leptonically producing a pair of high energy leptons in the final state. To examine this background a Monte Carlo simulation was performed using 10,000 generated $Z^0 \rightarrow$ t anti t events in which both top quarks decayed semi-leptonically for top quark masses of 25, 35 and 42.5 GeV/c². The results of this simulation are normalized to a sample of $10^6$ produced $Z^0$s. They show that the $H^0$ signal should be clear up to M/sub Higgs/ of 35-40 GeV/c² in the $e^+e^-$ channel. The $\mu^+\mu^-$ channel will provide a useful check up to masses of $\sim$ 30 GeV/c².

38186 (SLAC—306, pp 352-388) **Comparison of multihadronic event generators.** Petersen, A. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

In this paper we present general properties of hadronic final states produced by $e^+e^-$ annihilation at center-of-mass energies of E/sub cm/ = 29 GeV, measured with the Mark II detector at the PEP storage ring. Although these results stand on their own, it is interesting to compare them with future data taken in the 90 GeV region with the SLAC linear collider. It is also important to see whether these QCD plus fragmentation models are able to describe the data over such a wide energy range.

38187 (SLAC—306, pp 389-396) **Granlibakken meeting: b and c quark summary.** Ford, W.T. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Several topics addressed by the working group are briefly described. These include: the vertex detector, charm and bottom decays, lepton identification, bottom lifetime, top decay and Higgs production.

38188 (SLAC—306, pp 397-419) **Study of $D^+ \rightarrow K^-\pi^+\pi^+$ selection using the vertex drift chamber.** Hayes, K. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Use of the vertex chamber information allows us to select $D^+ \rightarrow K^-\alpha^+\alpha^+$ decays in $Z \rightarrow$ c anti c ($Z \rightarrow$ b anti b) events with an overall efficiency of about 15% (9%) for a signal-to-background ratio of about 4 (2). The physics which can be done with these selected decays depends on the size of the Z sample. In a sample of 10,000 hadronic Z decays, we could expect to tag about 16 $D^+$ from $Z \rightarrow$ c anti c and 11 $D^+$ from $Z \rightarrow$ b anti b events. There would be a few clean examples of $b \rightarrow c$ cascade decays where both decay vertices are well measured. With 100,000 Z decays, a good measurement of the $D^+$ production rate and x/sub D/ distribution in $Z \rightarrow$ c anti c and $Z \rightarrow$ b anti b decays could be made. We also may be able to make a reasonable measurement of the fraction of $D^+$ which have neutral parents. The $D^+$ sample could be combined with other b and c quark tagged samples to measure the Z decay assymmetry. With 1,000,000 Z decays we would have a fair chance to measure the average $D^+$ parent lifetime in $Z \rightarrow$ b anti b events. If the fraction of $D^+$ decays having neutral parents is sufficiently close to one, we could measure the charged and neutral B lifetimes.

38189 (SLAC—306, pp 432-442) **Counting neutrinos at SLC.** Thun, R. 1986. NTIS, PC A 14. File Number DE87010325. (CONF-8609174—).

From 2. Mark II workshop on SLC physics; Tahoe City, CA, USA (14 Sep 1986).

Determination of the number of neutrino species is an important physics goal within reach of the new high-energy electron-positron colliders. The MKII is a suitable detector for measuring both the $Z^0$ total decay width as well as the cross section of $e^+e^- \rightarrow \gamma$nu anti nu for this determination. For the latter measurement care must be taken to detect showering background particles down to angles of 15 m with high efficiency. At the desired level of accuracy, the width measurement requires an integrated luminosity of about $10^{36}$ cm⁻², whereas the single photon measurement is likely to require a dedicated run about 4 GeV above the $Z^0$ peak with an integrated luminosity of about 3 x $10^{36}$ cm⁻². These luminosity estimates are realistic in that they include some margin for efficiencies and systematic errors. The single-photon measurement can be attempted first in a parasitic mode while taking data on resonance. A prerequisite is that a viable single-photon trigger with an energy threshold of 1 GeV be added to the general MKII trigger. Whether or not the MKII collaboration succeeds in neutrino-counting will depend primarily on the SLC machine performance during the MKII era.

38190 (SLAC—312, pp 1-32) **Electroweak interactions - standard and beyond.** Harari, H. (Weizmann Institute of Science, Rehovot, Israel). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Several important topics within the standard model raise questions which are likely to be answered only by further theoretical understanding which goes beyond the standard model. In these lectures they present a discussion of some of these problems, including the quark masses and angles, the Higgs sector, neutrino masses, W and Z properties and possible deviations from a pointlike structure.

**38191** (SLAC—312, pp 223-230) **Theoretical understanding of charm decays.** Bigi, I.I. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A detailed description of charm decays has emerged. The author sketches the various concepts involved. Although this description is quite successful in reproducing the data the chapter on heavy flavor decays is far from closed. Relevant questions like on the real strength of weak annihilation, Penguin operators, etc. are still unanswered. He tries to identify important directions in future work, both on the experimental and theoretical side.

**38192** (SLAC—312, pp 231-238) **Toponium-$Z^0$ mixing.** Franzini, P.J. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

The subject of $Z^0$-toponium interference is briefly reviewed. The qualitative features of the $Z^0$ mixing with one t anti t state are discussed. Effects of mixing with the full t anti t spectrum, of the smearing due to beam spread, and of different potentials, are then shown.

**38193** (SLAC—312, pp 349-360) **Resonant neutrino oscillations.** Parke, S.J. (Fermi National Accelerator Lab., Batavia, IL). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Analytic results are derived for the electron neutrino survival probability after passage through a resonant oscillation region. This survival probability together with a sophisticated model of the production distribution of the solar neutrino sources and the solar electron number density are used to study the effects of resonant neutrino oscillation in the solar interior on the current and proposed solar electron neutrino experiments.

**38194** (SLAC—312, pp 693-702) **Compositeness below 1 TeV.** Jaffe, R.L. (Massachusetts Institute of Technology, Cambridge). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A composite model of quarks, leptons and gauge bosons is proposed. In this model, a version of the standard Glashow-Salam-Weinberg model in which the SU(2)sub L gauge interaction becomes strongly coupled, compositeness at energies below 1 TeV is predicted. An important question which is explored is how the Glashow-Salam-Weinberg Lagrangian is realized in nature. Constraints on compositeness are considered and electromagnetism in the model is discussed.

**38195** (SLAC—312, pp 703-712) **Changing view of hadron structure.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

Beginning before World War II, the author reviews the history of the realization that nucleons have structure. The author discusses early ideas such as Yukawa couplings of pions to nucleons and shows how the deficiencies of such models and data on pion scattering led to dispersion theory. The author then describes the rise of quark models and finally unified gauge models and quantum chromodynamics.

**38196** (SLAC-PUB—4315) **Overview of the standard model.** Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 16p. (CONF-870278—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010313.

From 4. family of quarks and leptons international symposium; Santa Monica, CA, USA (26 Feb 1987).

A few problem areas in relation to the standard model are discussed: the Kobayashi-Maskawa matrix, CP violation in the neutral kaon system, B-anti B mixing, and tau decays. 50 refs. (LEW)

**38197** (SLAC-PUB—4323) **Testing quantum chromodynamics in electroproduction.** Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 13p. (CONF-870165—8). NTIS, PC A02. File Number DE87011593.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

The exclusive channels in electroproduction are discussed. The study of color transparency, the formation zone, and other novel aspects of QCD by measuring exclusive reactions inside nuclear targets is covered. Diffractive electroproduction channels are discussed, and exclusive nuclear processes in QCD are examined. Non-additivity of nuclear structure functions (EMC effect) is also discussed, as well as jet coalescence in electroproduction. (LEW)

**38198** (UCRL—92902) **An experiment to measure the electron neutrino mass using a cryogenic tritium source.** Fackler, O.; Jeziorski, B.; Kolos, W.; Monkhorst, H.; Mugge, M.; Sticker, H.; Szalewicz, K.; White, R.M.; Woerner, R. (Lawrence Livermore National Lab., CA (USA); Rockefeller Univ., New York (USA); Warsaw Univ. (Poland); Waterloo Univ., Ontario (Canada); Florida Univ., Gainesville (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). 25 Jun 1985. Contract W-7405-ENG-48. 11p. (CONF-8504305—1). NTIS, PC A02. File Number DE87009587.

From Recontres de Moriond conference on weak interactions; Les Arcs, France (23 Apr 1985).

An experiment has been performed to determine the electron neutrino mass with the precision of a few eV by measuring the tritium beta decay energy distribution near the endpoint. Key features of the experiment are a 2 eV resolution electrostatic spectrometer and a high-activity frozen tritium source. It is important that the source have electronic wavefunctions which can be accurately calculated. These calculations have been made for tritium and the $HeT^+$ daughter ion and allow determination of branching fractions to 0.1% and energy of the excited states to 0.1 eV. The excited final molecular state calculations and the experimental apparatus are discussed. 4 refs., 5 figs.

**38199** **$E^+e^-\rightarrow W^+W^-$ in $E_6$ models with additional neutral gauge bosons.** Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **36**: No. 3, 713-718(1 Aug 1987). Contract W-7405-ENG-82.

We examine the influence of additional neutral gauge bosons (Z'), which can exist in $E_6$ models, on the total ($\sigma$) and differential ($d\sigma/dcos\theta$) sections for $e^+e^-\rightarrow W^+W^-$. Four different models of this kind with additional Z's are examined. We find that this process is quite sensitive to the existence of these new gauge bosons even if they are very heavy (M/sub Z//sub '/>1/2—1 TeV) and the Z-Z' mixing is small (sinphi≤0.025). The four models are distinguishable from each other and the standard model using data from either $\sigma$ or $d\sigma/d\cos\theta$ measurements.

**38200** **Branching, geometrical scaling, and Koba-Nielsen-Olesen scaling.** Chen, W.R.; Hwa, R.C. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). *Physical Review [Section] D: Particles and Fields;* **36**: No. 3, 760-764(1 Aug 1987).

The phenomenon of Koba-Nielsen-Olesen scaling up to about 100 GeV in c.m. energy in pp collision is described in a branching model supplemented by impact-parameter smearing with geometrical scaling as an essential input. A high-accuracy fit of all data points from CERN ISR is achieved by use of only one parameter, which relates the particle productivity to hadron opacity at each impact parameter. It is deduced that the average number of initial clusters is between 4 and 5, depending upon the energy.

**38201 Charge asymmetry of the nuclear interaction and neutron-neutron scattering parameters.** de Teramond, G.F.; Gabioud, B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 691-701(Aug 1987). Contract AC03-76SF00515.

Analyses of bound systems and low-energy scattering experiments give clear evidence of a departure from charge symmetry in the nuclear interaction. Furthermore, this effect could be enhanced in a nuclear medium thereby solving the Nolen-Schiffer anomaly observed in mirror nuclei. Since the extraction of the n-n scattering parameters is tied to the theoretical analysis of particular nuclear reactions, we have examined some theoretical treatments and approximations used in the study of the reaction $\pi^- d \to \gamma nn$ which is ideal for this purpose. In particular, we consider the neutron-neutron enhancement in higher n-n partial waves by introducing a simplified approach to the eigenamplitude and multipole expansions. We also give a description of the methods used in the calculation of the final state interactions in the $^1S_0$ n-n state to determine the low-energy n-n scattering parameters.

**38202 Fate of the m/sub b//m/sub tau/ mass relation in superstring theories.** Holman, R.; Reiss, D.B. (Fermi National Accelerator Lab., Batavia, IL, USA. Astrophysics Theory Group; Minnesota Univ., Minneapolis, USA. School of Physics and Astronomy). *Nuclear Physics* [*Section*] *B;* **288**: No. 1, 152-172(22 Jun 1987).

We consider the low energy limit of the E/sub 8/xE/sub 8/' heterotic superstring theory compactified on non-simply connected Calabi-Yau manifolds. We then determine what the consequences are of requiring that the m/sub b//m/sub tau/ mass relation be due to a Clebsch-Gordan relation as it is in traditional grand unified models.

**38203 Polarization density matrix for heavy Qanti Q production in hadron colliders.** Lee, S.C. (Fermi National Accelerator Lab., Batavia, IL, USA). *Physics Letters* [*Section*] *B;* **189**: No. 4, 461-465(14 May 1987).

We derive the polarization density matrix for the heavy quark-antiquark pair produced by gluon fusion or quark annihilation. These formulas are applied to find the angular correlations of the W/sup +/W/sup -/ pairs from ultra-heavy Qanti Q decays.

**38204 Indirect searches for ultra-heavy quarks in rare decays.** Bigi, I.I.; Wakaizumi, S. (Stanford Linear Accelerator Center, CA, USA; Hiroshima Univ., Japan. Dept. of Physics). *Physics Letters* [*Section*] *B;* **188**: No. 4, 501-505(23 Apr 1987). Contract AC03-76SF00515.

Existing accelerators will not allow the direct discovery of quarks with masses > or approx.M/sub w/. However such heavy objets can - via loop effects - have a significant impact on some rare decays, mainly of K and B mesons. Using a hierarchical model for the KM matrix we analyze the prospects for such an indirect search for ultra-heavy quarks.

**38205 Neutrino emission by the pair, plasma, and photo processes in the Weinberg-Salam model.** Schinder, P.J.; Schramm, D.N.; Wiita, P.J.; Margolis, S.H.; Tubbs, D.L. (Chicago Univ., IL; Pennsylvania Univ., Philadelphia; Aerospace Corp., Los Angeles, CA; Los Alamos National Lab., NM). *Astrophysical Journal;* **313**: 531-542(Feb 1987).

The results of numerical integrations of the rates and emissivities of the photo, pair, and plasma neutrino emission mechanisms in the Weinberg-Salam theory of the weak interaction are presented. The range of densities from 10 to 10 to the 14th g/cu cm and the temperature range from 10 to the 8th to 10 to the 11th K are considered. Fitting formulas, similar to those provided by Beaudet et al. (1967), which reproduce the authors' numerical result for the total emissivity to within 20 percent in the temperature range from 10 to the 8.2 to 10 to the 11th K, are presented. 26 references.

**38206 (DESY-L-Trans—317) Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method.** Kalinovskij, Yu.L.; Pervushin, V.N.; Sarikov, N.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR); AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). Jan 1987. Translation of JINR-P—2-86-308. 6p. NTIS, PC E07; Available from NTIS as TIB/B87-07040.

Translated from Russian.

The generalized phenomenological chiral Lagrangian method including spin-1 mesons together with pseudoscalar mesons and baryons is proposed for describing the nonleptonic decays of charmed baryons. This method (in comparison with the approaches based on quark models) allowed one to calculate the amplitudes of charmed baryon (particularly many-body) decay modes in a simpler way. The probabilities for the decays of λ/sup +/-baryon λ/sup +/ -> 1/2/sup +/ + 0/sup -/, λ' -> 1/2/sup +/ + 0/sup -/ + 0/sup -/ and λ/sup +/ -> 1/2/sup +/ + 1/sup -/ have been calculated, for which experimental values have been obtained for the first time. The theoretical value of probability ratio for λ/sup +/ -> λπ/sup +/ and λ/sup +/ -> pK/sup +/ is in agreement with its experimental value.

**38207 Physics simulations at high energy.** Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). 663p. (DOE/ER/40278—1; CONF-8605163—). World Sci. Publ. Co., Box 128, Farrer Rd., Singapore 9138. File Number TI87010800. Contract FG02-86ER40278.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Separate abstracts were prepared for 44 papers in these proceedings. (LW)

**38208 (DESY-L-Trans—315) Anomalies in radiation decays of charmed mesons.** Kalinovskij, Yu.L.; Pervushin, V.N.; Sarikov, N.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). Dec 1986. Translation of JINR-P—2-86-307. 11p. NTIS, PC E07; Available from NTIS as TIB/B87-04530.

Translated from Russian.

The amplitudes of the charmed meson decays D->O/sup -/+O/sup -/+γ and F->O/sup -/+O/sup -/+γ have been calculated in the framework of SU(4)center dotSU(4) - chiral Lagrangians with anomalies. It will be shown that E1-transitions do not exist in this approach.

**38209 Status of electroweak theory for heavy quark decays and CP violation.** Chau, L.L. (California Univ., Davis; Brookhaven National Lab., Upton, NY). pp 450-470 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The phenomena of quark mixing in weak interaction are described. The current experimental status of the mixing matrix, charm and beauty particle decays, and CP violations are reported. Future interesting experiments are pointed out, especially in the event that higher generations of quarks exist. 555 figures.

**38210 Constraints on general SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models from nuclear beta decay.** Herczeg, P. (Los Alamos National Lab., NM). pp 528-533 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

Here we shall analyze the implications of beta-decay experiments for more general versions of SU(2)/sub L/ x SU(2)/sub R/ x U(1) models, including the most general one which allows for CP-violation, unequal left- and right-handed quark mixing angles, and

mixing in the leptonic sector. For each scenario we shall compare the constraints on the pertinent parameters from beta-decay measurements with the constraints provided on them by other data. 555 figures.

## 6453 Particle Invariance Principles And Symmetries

*REFER ALSO TO CITATION(S) 38078, 38209, 38228, 38283*

**38211 Phenomenological clues for discrete symmetries in superstring theories.** Branco, G.C.; Geng, C.Q.; Marshak, R.E.; Xue, P.Y. (Physics Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] D: Particles and Fields;* **36**: No. 3, 928-931(1 Aug 1987).

It is shown that within the framework of the $E_8 \times E_8$ heterotic superstring if the Yukawa superpotential of the effective four-dimensional $E_8$ gauge theory is required to lead in a natural way to (i) no rapid proton decay, (ii) Fritzsch-type quark and charged-lepton mass matrices, and (iii) naturally small neutrino masses generated through radiative corrections, then for three generations a minimal $Z_8 \times Z_6$ symmetry is required. A minimal model based on this discrete symmetry is suggested and discussed. The generalization for more than three generations is analyzed.

**38212 Algebraic approach to scattering and the Euclidean connection.** Alhassid, Y. (Yale Univ., New Haven, CT). pp 29-36 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract AC02-76ER03074.

Starting from a dynamical group describing a scattering problem the author explains how the S-matrix can be calculated algebraically through the technique of Euclidean connection. The S-matrix corresponding to the dynamic group SO(3,2) is constructed explicitly and provides a realistic model for the analysis of heavy-ion collisions. 13 references.

**38213 General Dynkin indices and their applications.** Okubo, S. (Univ. of Rochester, NY). pp 419-428 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract AC02-76ER13065.

The notion of general Dynkin indices for representations of simple Lie algebras is defined and their various applications in self-conjugate representations, Clebsch-Gordan decomposition, decomposition of tensor-power representations, and trace identities are discussed. 29 references.

## 6454 Field Theory

*REFER ALSO TO CITATION(S) 38121, 38146, 38190, 38194, 38195, 38211, 38314*

**38214 (ANL-HEP-CP—87-15) Unorthodox lattice fermion derivatives and their shortcomings.** Bodwin, G.T.; Kovacs, E.V. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA). Dept. of Physics). 10 Mar 1987. Contract W-31109-ENG-38. 21p. (CONF-870121—10; UIC—87-14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011482.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

We discuss the DWY (Lagrangian), Quinn-Weinstein, and Rebbi proposals for incorporating fermions into lattice gauge theory and analyze them in the context of weak coupling perturbation theory. We find that none of these proposals leads to a completely satisfactory lattice transcription of fully-interacting gauge theory.

**38215 (BNL—39747) Monte Carlo algorithms for lattice gauge theory.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 35p. (CONF-8705129—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87010045.

From Workshop on lattice gauge theory using parallel processors; Beijing, China (21 May 1987).

Various techniques are reviewed which have been used in numerical simulations of lattice gauge theories. After formulating the problem, the Metropolis et al. algorithm and some interesting variations are discussed. The numerous proposed schemes for including fermionic fields in the simulations are summarized. Langevin, microcanonical, and hybrid approaches to simulating field theories via differential evolution in a fictitious time coordinate are treated. Some speculations are made on new approaches to fermionic simulations.

**38216 (DOE/ER/40272—37) Curvature of Super $\mathrm{DiffS}^1/\mathrm{S}^1$.** Oh, P.; Ramond, P. (Florida Univ., Gainesville (USA). Dept. of Physics). 6 Apr 1987. Contract FG05-86ER40272. 12p. (UFTP—87-9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011205.

Motivated by the work of Bowick and Rajeev, we calculate the curvature of the infinite-dimensional flag manifolds $\mathrm{DiffS}^1/\mathrm{S}^1$ and Super $\mathrm{DiffS}^1/\mathrm{S}^1$ using standard finite-dimensional coset space techniques. We regularize the infinity by zeta-function regularization and recover the conformal and superconformal anomalies respectively for a specific choice of the torsion.

**38217 (DOE/ER/40272—38) The superstring, $\mathrm{DiffS}^1/\mathrm{S}^1$, and holomorphic geometry.** Harari, D.; Hong, Deog Ki; Ramond, P.; Rodgers, V.G.J. (Florida Univ., Gainesville (USA). Dept. of Physics). Apr 1987. Contract FG05-86ER40272. 29p. (UFTP—87-10). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011206.

We incorporate superstrings into the non-perturbative formulation of string field theories based on Kahler geometry recently proposed by Bowick and Rajeev. The string field is conjectured to be the Kahler potential of loop space, its equation of motion given by the vanishing of the curvature of a product bundle constructed over a graded $\mathrm{DiffS}^1/\mathrm{S}^1$, as required for reparametrization invariance of the theory. We find that bosonic and fermionic loops in a Minkowski background solve the equation for the Kahler potential only in ten dimensions. We use geometric quantization techniques to calculate the curvature of the superholomorphic vector bundle, since they emphasize the role of the complex geometry, and flag manifold techniques to calculate the curvature of the line bundle over $\mathrm{SuperDiffS}^1/\mathrm{S}^1$.

**38218 (LBL—23122) The standard model and colliders.** Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 104p. (CONF-8607326—1; CONF-8607327—1). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010260.

From Summer school on techniques in experimental high energy physics; St. Croix, Virgin Islands, U.S. (1 Jul 1986).

Some topics in the standard model of strong and electroweak interactions are discussed, as well as how these topics are relevant for the high energy colliders which will become operational in the next few years. The radiative corrections in the Glashow-Weinberg-Salam model are discussed, stressing how these corrections may be measured at LEP and the SLC. CP violation is discussed briefly, followed by a discussion of the Higgs boson and the searches which are relevant to hadron colliders are then discussed. Some of the problems which the standard model does not solve are discussed, and the energy ranges accessible to the new colliders are indicated. (LEW)

**38219 (PREPRINT—42) Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems.** Castellani, C.; Dicastro, C.; Strinati, G. (Rome Univ. (Italy)). Jan 1987. 14p. (ETN—87-99756). NTIS, PC A02/MF A01.

The renormalization of the specific heat and of the thermal diffusion coefficient due to the electron-electron interaction in the presence of disorder is determined by exploiting the skeleton structure of the heat response function in conjunction with the constraints originating from energy conservation (in the form of a Ward identity). This analysis leads to a generalization of the Wiede-

mann-Franz law near the localization transition with inclusion of interaction effects.

38220 (SLAC—312, pp 53-122) **Perturbative QCD: K-factors.** Field, R.D. (Univ. of Florida, Gainesville). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—). Contract FG05-86ER40272.

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A pedagogical series of lectures on the perturbative applications of Quantum chromodynamics (QCD) is presented. Detailed calculations are made for $e^+e^-$ annihilations, deep inelastic scattering, and the Drell-Yan process. Emphasis is placed on the way one handles the infrared and mass singularities that arise in QCD. Two regularization schemes, massive glue and dimensional regularization, are studied. The origin and significance of K-factors is explained.

38221 (SLAC—312, pp 123-190) **Experimental tests of quantum chromodynamics.** Dorfan, J. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A large body of data which relates to testing QCD is reviewed. The qualitative agreement between the data from a very wide range of processes and QCD is very impressive. This agreement is non-trivial in the sense that there exist no other theories or models which fit the data nearly as well. Quantitatively quarks have spin 1/2 and come in three colors and that gluons are vector-like particles. Direct experimental evidence for the triple gluon vertex is not seen; however most data are poorly fit (p anti p at CERN in particular) without such a contribution. Further indirect evidence comes from the fact that gluons appear to have a softer fragmentation function than quarks. Extracting the QCD scale LAMBDA is problematical and there exists no processes where a precise, non-controversial measurement can be made. All measurements seem entangled with either experimental or theoretical problems or both. However if it is assumed that all the measurements taken as a whole average out these problems, one is left reasonably satisfied with LAMBDA/sub QCD/ = 150 +/- 100 MeV.

38222 (SLAC—312, pp 643-666) **Superstring spectroscopy.** Peskin, M.E. (Stanford Univ., CA). Jan 1987. NTIS, PC A99/MF A01. File Number DE87009268. (CONF-860736—).

From 14. SLAC summer institute on particle physics; Stanford, CA, USA (28 Jul 1986).

A basic tutorial on string theory is presented. After a brief discussion of the properties of string theories the author gives 8 lessons on different aspects of the theories. These include: quantization, zero-point energy, bosonic strings, compactification, supersymmetry and symmetry groups.

38223 (SLAC-PUB—4251) **Introduction to string and superstring theory II.** Peskin, M.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 66p. (CONF-8606259—5). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010542.

From Theoretical Advanced Study Institute conference; Santa Cruz, CA, USA (23 Jun 1986).

Conformal field theory is reviewed, then conformal invariance is used to rederive the basic results on the embedding dimensionality for bosonic and fermionic strings. The spectrum of the bosonic and the computation of scattering amplitudes are discussed. The formalism used is extended to clarify the origin of Yang-Mills gauge invariance in the open bosonic string theory. The question of the general-coordinate gauge invariance of string theory is addressed, presenting two disparate viewpoints on this question. A brief introduction is then given of the reduction from the idealized string theory in 10 extended dimensions to more realistic solutions in which all but 4 of these dimensions are compactified. The state of knowledge about the space-time supersymmetry of the superstring from the covariant viewpoint is outlined. An approach for identifying possible 6-dimensional spaces which might represent the form of the compact dimensions is discussed, and the orbifold scheme of compactification is presented. 77 refs., 18 figs. (LEW)

38224 (SLAC-PUB—4316) **How to measure $\epsilon'/\epsilon$ with lattice QCD.** Sharpe, S.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 12p. (CONF-870390—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010312.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

A pedagogical discussion is given of a lattice calculation of $\epsilon'$. The method is outlined, and preliminary results are presented. They suggest that $\epsilon'/\epsilon$ may be reduced from previous estimates by 60-70%.

38225 **Superconducting cosmic strings with massive fermions.** Hill, C.T.; Widrow, L.M. (Fermi National Accelerator Lab., Batavia, IL, USA; Chicago Univ., IL, USA. Astrophysics Center; Chicago Univ., IL, USA. Dept. of Physics). *Physics Letters [Section] B;* **189**: No. 1/2, 17-22(30 Apr 1987).

Fermions which couple to the fields comprising a Nielsen-Olesen vortex (cosmic string) can generally exist as massive bound modes on the string. If these fermions carry electromagnetic charge then the string will interact with external elecromagnetic fields in a manner significantly altered from the superconducting string scenario of Witten. The current in the string oscillates at a characteristic resonant frequency, proportional to $\mu$, and therefore produces a signature of narrow band radiation. We also give an accounting of the relevant anomalies responsible for fermionic superconducting strings.

38226 **Broken symmetry and the accelerated observer.** Hill, C.T. (Fermi National Accelerator Lab., Batavia, IL). pp 225-234 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986).

Coordinate systems possessing horizons lead to certain ambiguities in the definition of a quantum field theory. They attempt to define a Hamiltonian, H/sub h/, which propagates the Schroedinger wave-functional of the quantum field theory in the accelerated observer's coordinate time. However, the singularity in the coordinate system on the horizon translates into ambiguities in the definition of the Hamiltonian density at the horizon and hence the Hamiltonian integral across the horizon. This coordinate system ambiguity represents a loss of information which must somehow be reincorporated to maintain consistency with the Minkowski space definition. However, in the literature this subtlety is generally ignored; one simply writes down an expression for the Hamiltonian with unspecified constraints upon the field configuration at the horizon. They refer to this naive prescription as the Rindler Hamiltonian. The ground state of the Rindler Hamiltonian is the Unruh vacuum and is seen to have lower energy than the Minkowski ground state. 11 references.

38227 **Double covering of diffeomorphisms for superstrings in generic curved space.** Ne'eman, Y.; Sijacki, D. (Tel Aviv Univ., Israel). pp 381-391 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract FG05-85ER40200.

The embedding of the superstring in a generic curved space involves the use of world-spinors behaving according to the (infinite) unitary representations of SL(10,IR), the double-covering of the linear group on $R^{10}$. A supersymmetric extension is provided by the embedding of GL(10,IR) in the supergroup GQ(10, IR) whose flat limit reproduces Poincare supersymmetry. 23 references.

38228 **Light and group theory.** Sudarshan, E.C.G. (Univ. of Texas, Austin). pp 483-492 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract FG05-85ER40200.

The transmission of light energy by complexes of pencils has been the subject of study in radiative transfer. In such studies they attempt to treat light as a collection of pencils, whose rays propagate rectilinearly. Since they can consider arbitrarily narrow pencils the radiant energy transfer can be reduced to integrodifferential equations. They must expect substantial modification of the whole framework of radiative transfer when quantum ideas are invoked. Light has the attribute of polarization, which cannot be satisfactori-

ly taken account of in conventional radiative transfer. Further since quantum theory of light demands that the wave aspect is essential, arbitrarily narrow pencils cannot be entertained; diffraction effects would then prevent rectilinear propagation. In the context of quantum electrodynamics they have still further elaborations to be made. The field strengths now become quantum operators. However, that the first fundamental theorem of quantum optics asserts that every quantum illumination can be expressed as an ensemble of coherent wave fields with a possibly singular ensemble density. Each coherent field can for many purposes be thought of as a classical wavefield. So at least as far as lossless transmission in passive media is considered, the full quantum electrodynamic behavior can be described as if they have an ensemble of classical wave fields. They rely on this fundamental theorem and treat optics as if it is classical wave optics with ensembles of wavefields as representative illuminations.

# 65 PHYSICS II

*REFER ALSO TO CITATION(S) 36972*

## 6510 Nuclear Physics

*REFER ALSO TO CITATION(S) 37529*

**38229 (DOE/ER/10638—7) Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987].** Hoffmann, G.W. (Texas Univ., Austin (USA). Dept. of Physics). Dec 1986. Contract AS05-80ER10638. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010304.

A major part of the work done this past year was associated with research conducted at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) using the High Resolution Spectrometer (HRS) and the External Proton Beam (EPB). The research focussed on (1) providing p + nucleus data which test nonrelativistic and relativistic models of the medium energy proton + nucleus interaction, (2) providing (p,p) and (p,n) data which are to be analyzed to provide new nuclear structure information (both ground state and excited state), (3) providing nucleon + nucleon data to aid in the systematic study of the fundamental nucleon-nucleon interaction, (4) developing and improving the pA models themselves, and (5) initiating new experimental programs whose goals are to search for new phenomena in nuclear physics.

**38230 (DOE/ER/40150—15) CEBAF [Continuous Electron Beam Accelerator Facility] scientific program.** Gross, F. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA); College of William and Mary, Williamsburg, VA (USA). Dept. of Physics). 1986. Contract AC05-84ER40150. 37p. (CEBAF-PR—86-013; CONF-8606241—8). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008672.

From 3. Continuous Electron Beam Accelerator Facility summer school; Newport News, VA, USA (23 Jun 1986).

The principal scientific mission of the Continuous Electron Beam Facility (CEBAF) is to study collective phenomena in cold (or normal) nucler matter in order to understand the structure and behavior of macroscopic systems constructed from nuclei. This document discusses in broad popular terms those issues which the CEBAF experimental and theoretical program are designed to address. Specific experimental programs currently planned for CEBAF are also reivewed. 35 refs., 19 figs. (DWL)

**38231 (KFK—4159) Annual report on nuclear physics activities. July 1, 1985-June 30, 1986.** Bueche, G.; Doll, P.; Friedrich, L. (eds.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1986. 253p. NTIS, PC E17; Available from NTIS as TIB/B87-07048.

This report surveys the activities in basic research from July 1, 1985 to June 30, 1986 at the Institute for Nuclear Physics (IK) of the Kernforschungszentrum Karlsruhe. The research program of this institute comprises laser spectroscopy, nuclear reactions with light ions, neutron physics, neutrino physics and physics at medium and high energies.

**38232 (NP—7900796) Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984.** Yamaguchi, Yoshio. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 1984. 196p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87900796.

The Institute for Nuclear Study was established in 1955, in order to promote research activities in nuclear and particle physics in our country. The facilities of the Institute are open to all researchers throughout the country. At present, four research divisions are active: the Low-Energy Division, the High-Energy Division, the Theory Division, and the Study Group for High-Energy Heavy-Ion Project.

## 6511 Experimental Techniques

*REFER ALSO TO CITATION(S) 38230, 38243, 38249, 38250, 38259, 38294*

**38233 (CONF-870501—6) Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range.** Smith, D.L.; Meadows, J.W.; Guenther, P.T.; Greenwood, L.R. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011433.

From 6. ASTM-Euratom symposium on reactor dosimetry; Jackson Hole, WY, USA (31 May 1987).

Bombardment of thick Be-metal targets with several-MeV deuterons produces continuum-neutron fields which offer considerable potential for the development and validation of neutron-reaction cross sections. A facility based on this concept has been installed at the Argonne National Laboratory FNG accelerator. A description is provided of this facility and of the research studies which have been initiated to exploit its capabilities. Some technical considerations in the utilization of accelerator-produced continuum-neutron fields for reaction cross-section investigations are discussed. Results from several recent neutron-spectrum and integral cross-section measurements are presented, and the implications are reviewed. 13 refs., 8 figs.

**38234 (DOE/ER/40150—2) Electromagnetic studies in nuclei.** Gross, F. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1985. Contract AC05-84ER40150. 18p. (CEBAF—85-003; CONF-8503120—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008679.

From Hadronic probes and nuclear interactions conference; Tempe, AZ, USA (11 Mar 1985).

This talk is devoted to a brief review of the experimental program for the new generation of multi-GeV continuous beam electron accelerator facilities. First, the kinematic variables used in electron scattering are reviewed, three experiments which are representative of previous work in this field are described, and some comparisons are made between electron and hadronic probes. The main part of the talk then describes seven experiments proposed for the future. These are concerned with the structure of light nuclei, the structure of mesons and baryons, the influence of the nuclear medium on hadronic interactions, and the weak interactions. 14 refs., 17 figs.

**38235 (DOE/ER/40150—9) Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility].** Burkert, V. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 12p. (CEBAF-PR—86-008; CONF-860575—62). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008677.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Some aspects of a tentative program for using high current polarized electron beams as well as solid state targets with high nucleon and deuteron polarization in nuclear physics experiments at CEBAF are briefly discussed. 14 refs., 4 figs.

38236 **The Los Alamos free atomic tritium beta decay experiment.** Knapp, D.A.; Bowles, T.J.; Browne, J.C.; Burritt, T.H.; Cohen, J.S.; Helffrich, J.A.; Maley, M.P.; Martin, R.L.; Robertson, R.G.H.; Wilkerson, J.F. (Los Alamos National Lab., Los Alamos, NM 87545). pp 57-62 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

An apparatus is under construction at Los Alamos to measure the beta spectrum of free tritium atoms and molecules. The tritium atoms decay in a gaseous windowless source and are analyzed by a Tret'yakov type toroidal field beta spectrometer. The ultimate sensitivity of the experiment to electron antineutrino mass is expected to be $<10$ eV.

## 6513 Nuclear Properties And Reactions, A=6-19, Experimental

38237 **(BNL—39723) Studies of hypernuclei by associated production.** Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-870413—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010448.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The effectiveness of the associated production, the ($\pi^+$,$K^+$) technique, for obtaining hypernuclear spectra across the whole periodic table is demonstrated. Binding energy spectra for hypernuclei of beryllium-9, carbon-12, carbon-13, oxygen-16, silicon-28, calcium-40, vanadium-51, and yttrium-89 were measured. The Low-Energy-Separated Beam I at the Brookhaven National Laboratory AGS was used with the Moby Dick spectrometer. A rate of 2 million pions per beam spill was used for targets of beryllium-9, carbon-12, water, silicon, and calcium. A rate of 10 million pions per beam spill was used for carbon-13, vanadium-51, calcium, and yttrium-89. The higher beam rates were necessary for the low cross sections for the ground states of heavier targets. All of the spectra for hypernuclei above the p-shell show the presence of a continuum apparently underlying the peaks of the bound state region. 4 refs., 5 figs., 1 tab.

38238 **(DOE/ER/03591—1) Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987.** (New Mexico State Univ., Las Cruces (USA)). 30 Jun 1987. Contract AS04-76ER03591. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012099.

This report summarizes the work on experimental research in intermediate energy nuclear and particle physics carried out by New Mexico State University in 1985-87. These studies have involved investigations of nucleon-nucleon and pion-nucleus interactions. They have been carried out at the LAMPF accelerator at the Los Alamos National Laboratory, at the SIN laboratory near Zurich, Switzerland, and at the TRIUMF accelerator in Vancouver, Canada. 86 refs., 5 figs.

38239 **(LBL—23570) Probing the direct step of relativistic heavy ion fragmentation: ($^{12}$C, $^{11}$B+p) at 2.1 GeV/nucleon with C and $CH_2$ targets.** Webb, M.L. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011914.

Relativistic heavy ion collisions may be classified as central (and near central), peripheral, and grazing with each collision type producing different proton and other charged projectile fragment scattering mechanisms and characteristics. This report focuses on peripheral and grazing collisions in the fragmentation of Carbon-12 into Boron-11 and a proton, testing models of the kinetics involved in this reaction. The data were measured at the Heavy Ion Superconducting Spectrometer (HISS) at Lawrence Berkeley Laboratory and include excitation energy for the p/Boron-11 pair, and rapidity versus transverse momentum for protons and Boron-11. 58 refs., 35 figs., 8 tabs. (DWL)

38240 **Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers.** Hicks, R.S.; Huffman, R.L.; Lindgren, R.A.; Peterson, G.A.; Plum, M.A.; Button-Shafer, J. (University of Massachusetts, Amherst, Massachusetts 01003). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 485-490(Aug 1987).

Form factors for transverse electron scattering from /sup 12/C and /sup 13/C have been determined for momentum transfers as high as q = 4.6 fm/sup -1/. Data are presented for the elastic (M1), 3.088 MeV (E1), and 9.50 MeV (M4) transitions in /sup 13/C, and for the 15.11 MeV (M1), 16.11 MeV (E2), and 16.58 MeV (M2) transitions in /sup 12/C. It is found that calculations in the lowest-order shell-model space fail to account for the measured q dependences of E1, M1, and E2 form factors beyond q = 2 fm/sup -1/. On the other hand, form factor shapes observed for M2 and M4 multipoles are satisfactorily described to q = 4 fm/sup -1/ within the minimal 1h-dash-barω configuration space.

38241 **(p-arrow-right,n) reaction on carbon isotopes at E/sub p/ = 160 MeV.** Rapaport, J.; Wang, D.; Carr, J.A.; Petrovich, F.; Foster, C.C.; Goodman, C.D.; Gaarde, C.; Larsen, J.; Goulding, C.A.; Taddeucci, T.N.; and others. (Ohio University, Athens, Ohio 45701). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 500-512(Aug 1987).

Differential cross sections and analyzing powers for the (p-arrow-right,n) reaction on carbon isotopes have been measured for angles up to θ/sub lab/ = 50° using 160 MeV protons. The angular distributions for the stronger transitions are compared with the results of distorted-wave impulse approximation calculations which utilize transition densities from existing shell model calculations. The total observed Gamow-Teller strength is also compared with the shell model predictions. In addition, the shapes of these angular distributions are discussed emphasizing decomposition into longitudinal, transverse, and non-normal-parity-transfer components. Some comparisons of the present (p,n) data with corresponding (p,p') data and with other relevant (p,n) data are also made.

38242 **Electromagnetic transitions in hypernuclei.** Chrien, R.E. (Brookhaven National Lab., Upton, NY). pp 587-591 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

## 6514 Nuclear Properties And Reactions, A=20-38, Experimental

38243 **Limits on likesign dilepton production in ν/sub μ/ interactions.** Baker, N.J.; Connolly, P.L.; Kahn, S.A.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tanaka, M.; Baltay, C.; Bregman, M.; Hibbs, M. (Brookhaven National Lab., Upton, NY 11973). pp 1-10 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

We have searched for the production of likesign dilepton events (ν/sub μ/ + Ne → μ/sup -/ + e/sup -/ + ...) in a wide-band neutrino beam at FNAL using the 15' bubble chamber. The authors observe no signal above the background arising from conventional sources. We set 90% confidence level upper limits for the production rates of (ν/sub μ/ + Ne → μ/sup -/ + e/sup -/ + ...) /(ν/sub μ/ + Ne → μ/sup -/ + ...) ≦ 8 * 10/sup -5/ and (μ/sub ν + Ne → μ/sup -/ + e/sup -/ + ...)/(ν/μNe → μ/sup -/ + E/sup +/ + ..) ≦ 6 * 10/sup -2/.

## 6516 Nuclear Properties And Reactions, A=59-89, Experimental

**38244 (DOE/ER/40048—192) Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu.** Kicinska-Habior, M.; Snover, K.A.; Gossett, C.A.; Behr, J.A.; Feldman, G.; Glatzel, H.K.; Gundlach, J.H.; Garman, E.F. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). [1987]. Contract AC06-81ER40048. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009711.

Continuum γ-ray spectra from decays of $^{63}$Cu formed at initial excitation energies of 22.5 to 77.4 MeV and maximum spin up to 40 h-bar, using $^{4}$He + $^{59}$Co, $^{6}$Li + $^{57}$Fe, $^{12}$C + $^{51}$V, and $^{18}$O + $^{45}$Sc entrance channels, have been measured and analyzed. The parameters of the GDR strength function have been extracted using the statistical code CASCADE in a nonlinear least-squares fitting routine. Except for the cases of $^{4}$He and $^{6}$Li at the highest bombarding energies, which show evidence for nonstatistical effects, spectra are well-reproduced by statistical calculations. The mean energy and strength of the giant dipole resonance built on excited states of $^{63}$Cu are close to the ground-state values, while the width varies smoothly from ~5 MeV for the ground-state GDR up to 10.6 +- .6 MeV in the temperature range up to 1.9 MeV and mean spin in the range 0 to 23 h-bar. The large range of energies studied permitted different level density formulations to be tested. Measured spectra from $^{6}$Li + $^{98}$Mo and $^{6}$Li + $^{181}$Ta at E/sub lab/($^{6}$Li) = 36 MeV show a strong nonstatistical enhancement at high γ-ray energies. 52 refs., 14 figs., 3 tabs.

**38245 (HEDL-SA—3530) 1986 evaluation of delayed-neutron emission probabilities.** Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 13 Aug 1986. Contract AC06-76FF02170. 12p. (CONF-8609161—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010726.

From Meeting on delayed neutrons; Birmingham, UK (15 Sep 1986).

Delayed-neutron data are being compiled in preparation for a new ENDF/B evaluation of delayed-neutron data. An evaluation of the probability of delayed-neutron emission, Pn, for 85 precursors using data published through the end of 1985 has been performed using preliminary ENDF/B fission yields and decay data. The evaluation, differences from the 1984 Pn evaluation, and implications of the new evaluation will be discussed. 33 refs., 5 figs.

**38246 Microscopic distorted-wave approximation study of low-energy nucleon scattering from /sup 89/Y.** Mellema, S.; Petler, J.S.; Finlay, R.W.; Dietrich, F.S.; Carr, J.A.; Petrovich, F. (Department of Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 2, 577-584(Aug 1987).

New differential cross section data for inelastic neutron scattering to the first three excited states of /sup 89/Y at E/sub n/ = 11 MeV are studied using a microscopic folding model and three energy- and density-dependent effective interactions. Results are also presented for the corresponding transitions in inelastic proton scattering at 14.7, 24.5, and 61.2 MeV. Transition densities were obtained from a combination of available inelastic electron-scattering data and theoretical considerations. The calculated angular distributions provide a reasonable description of the experimental data for the predominantly quadrupole (ΔJ = 2), (1/2$^-$→(3/2$^-$ (E/sub x/ = 1.509 MeV) and (1/2$^-$→(5/2$^-$ (E/sub x/ = 1.745 MeV) transitions in the target. It is shown that the neutron scattering data for these two transitions are sensitive to the shape differences in the transition densities suggested by theory and electron scattering. The theoretical results for the predominantly ΔJ = 5, (1/2$^-$→(9/2$^+$ (E/sub x/ = 0.909 MeV) transition significantly underestimate the proton and neutron scattering cross sections at E/sub p/<25 MeV and E/sub n/ = 11 MeV, but provide a reasonable description of the proton scattering data for this transition at E/sub p/ = 61.2 MeV.

**38247 Neutron capture cross sections for $^{86}$Sr and $^{87}$Sr at stellar temperatures.** Bauer, R.W.; Mathews, G.J.; Becker, J.A.; Howe, R.E.; Ward, R.A. (Lawrence Livermore National Lab., CA). pp 984-985 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—). Contract W-7405-ENG-48.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

**38248 Ultralow background searches for ββ-decay, cold dark matter and solar axions.** Avignone, F.T. III; Miley, H.S.; Ahlen, S.P.; Brodzinski, R.L.; Reeves, J.H.; Dimopolous, S.; Starkman, G.D.; Drukier, A.K.; Gelmini, G.; Spergel, D.N. (South Carolina Univ., Columbia; Boston Univ., MA; Battelle Pacific Northwest Labs., Richland, WA; Stanford Univ., CA; Harvard-Smithsonian Center for Astrophysics, Cambridge, MA). pp 676-680 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

An ultralow background Ge detector in the Homestake gold mine is applied to searches for O$\nu$ ββ-decay, cold dark matter candidates and invisible axions from the sun. A large body of low background Ge data imply <m/sub ν/>< or approx.2.3 eV. Particles with spin independent $Z^0$ exchange interactions and masses between 20 GeV and 5 TeV are excluded as dominant in the galactic halo. Finally, axions with F/2x/sub e/'< or approx.0.5x10$^7$ GeV are also ruled out. 555 figures.

**38249 A /sup 82/Se double Beta decay experiment.** Moe, M.K.; Hahn, A.A.; Elliott, S.R. (Univ. of California, Irvine, CA 92717). pp 156-167 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

In 70 days of live time with an enriched /sup 82/Se source in a TPC, 30 double-beta-like events have survived cuts imposed to eliminate known backgrounds. The identity of these events is still undetermined. They are consistent with a /sup 82/Se half life of > 4.1 x 10/sup 19/ years at the 90% confidence level. The absence of events near the 3.0 MeV endpoint corresponds to a limit on the neutrinoless half life of > 1.4 x 10/sup 21/ years, also at 90% confidence. Data accumulation continues in an attempt to measure a definitive two-neutrino results, and extend the sensitivity to the neutrinoless mode.

**38250 Status of double beta decay of Ge.** Caldwell, D.O. (Univ. of California, Santa Barbara, CA 93106). pp 120-127 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

The search for neutrinoless double beta decay in /sup 76/Ge is being pursued vigorously world-wide, since the process tests lepton number conservation and could provide a measure of neutrino mass (m/sub ν/) and right-handed currents (RHC). Although greatly improved experiments are coming into operation, the lifetime limit for this decay is already about 10/sup 23/ years. The experimental situation is reviewed and the relation of lifetime results to m/sub ν/ and RHC is discussed.

## 6517 Nuclear Properties And Reactions, A=90-149, Experimental

**38251 (CONF-8706113—2) Angular momentum effects in subbarrier fusion.** Halbert, M.L.; Beene, J.R.; Hensley, D.C.; Honkanen, K.; Semkow, T.M.; Abenante, V.; Sarantites, D.G.; Li, Z. (Oak Ridge National Lab., TN (USA); Washington Univ., St. Louis, MO (USA)). Jun 1987. Contract AC05-84OR21400;AC02-76ER04052. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010892.

From 6. Adriatic international conference on nuclear physics; Dubrovnik, Yugoslavia (15 Jun 1987).

Angular-momentum distributions σ/sub l/ for the compound nucleus $^{164}$Yb were deduced from measurements of γ-ray multiplicity for all significant evaporation residues from fusion of $^{64}$Ni and $^{100}$Mo and $^{16}$O + $^{148}$Sm. At the lowest bombarding energies and the σ/sub l/ extend to higher l values than do predictions that include coupling of the principal inelastic channels, even if the coupling strengths are increased to match the experimental excitation function. Likewise, σ/sub l/ from an energy-dependent real potential fitted to the excitation function fails to reproduce the experimental σ/sub l/ distribution. No effects attributable to superdeformation were observed. 17 refs., 6 figs., 1 tab.

38252 **(GSI—87-3) Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin.** Rathke, G.E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.)). Feb 1987. 69p. NTIS, PC E09; Available from NTIS as TIB/B87-07044.

Neutron-deficient /sup 108,106,104/Sn isotopes were produced by heavy ion induced fusion reactions using high-intensity / sup 59/Ni beams from the UNILAC of the GSI. Their decay properties were studied by techniques of gamma and conversion electron spectroscopy employing the mass separator on-line to the UNILAC. Earlier information on the /sup 108/Sn -> /sup 108/In and /sup 106/Sn -> /sup 106/In decays was complemented and improved in the course of this work. The new nucleus /sup 104/Sn and its decay to excited states in /sup 104/In was identified and studied for the first time. These investigations yield the following results: the mass of /sup 104/Sn and of nuclei linked to it by alpha decay or proton radioactivity, /sup 108/Te, /sup 112/Xe and /sup 109/I, /sup 113/Cs, respectively were determined from the measured Q/sub EC/ value of /sup 104/Sn and the known mass value of /sup 104/In. These are nuclei very close or beyond the proton drip line. In addition, information on the quenching of the fast Gamow-Teller beta decay of the even neutron-deficient tin isotopes was obtained. This complements investigations on the N = 50 isotones /sup 94/Ru and /sup 96/Pd, and allows a systematic comparison of these transition strengths for nuclei near the doubly magic / sup 100/Sn. The spreading of the vertical stroke πg/sub 9/2//sup -1/ νg /sub 7/2/, 1/sup +/ > configuration over several states, due to residual interactions, and the centroid energies of these magnetic dipole states were determined for the corresponding odd-odd indium isotopes. (orig./HSI).

38253 **Observation of /sup 149/Tm decay to /sup 149/Er levels and β-delayed proton emission.** Toth, K.S.; Gilat, J.; Nitschke, J.M.; Wilmarth, P.A.; Vierinen, K.; Avignone III, F.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 826-829(Aug 1987). Contract AC05-84OR21400.

With the use of an on-line isotope separator, /sup 149/Tm (T/sub 1/2/ = 0.9 +- 0.2 s) was identified in /sup 58/Ni bombardments of /sup 94/Mo. Seven γ rays were observed to follow the isotope's ($\beta^+$ + electron capture) decay, including the 111.3-keV transition known from /sup 149/Er/sup m/ isomeric decay to be the d/sub 3/2/ (111.3 keV)→s/sub 1/2/ (0.0 keV) γ ray in /sup 149/Er. In addition to the previously known levels at 111.3 (d/sub 3/2/) and 741.5 (h/sub 11/2/) keV in /sup 149/Er, our data establish three other excited states, at 907.4 ((5/2$^+$), 1066.2 ((7/2$^-$), and 1482.9 ((9/2$^-$, (11/2$^-$) keV. Coincidences observed between Er K x rays and protons in the A = 149 mass chain show that /sup 149/Tm is a β-delayed proton precursor.

38254 **Intermediate-mass fragments from nonbinary processes in the reaction of /sup 14/N on Ag at E/A = 35 MeV.** Bougault, R.; Horn, D.; Chitwood, C.B.; Fields, D.J.; Gelbke, C.K.; Klesch, D.R.; Lynch, W.G.; Tsang, M.B.; Kwiatkowski, K. (Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada K0J 1J0). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 830-833(Aug 1987).

Angular distributions of recoil nuclei were measured in coincidence with low-energy intermediate-mass fragments emitted in / sup 14/N-induced reactions on Ag at E/A = 35 MeV. The measured correlations are inconsistent with a purely binary reaction mechanism. The incomplete linear momentum transfer mechanism alone does not reproduce the data, which show evidence for emission of additional matter to the same side of the beam axis as the intermediate-mass fragment.

38255 **(DESY-L-Trans—318) Observation of π/sup 0/π/sup 0/-interference effect and size of neutral pion emission volume in π/sup -/Xe-interactions at 3.5 GeV/c.** Grishin, V.G.; Miller, K.; Pluta, J.; Pawliak, T.; Peryt, W.; Strugalski, Z. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Joint Inst. for Nuclear Research, Dubna (USSR); Politechnika Warszawska (Poland)). Feb 1987. Translation of JINR-P—1-86-585. 8p. NTIS, PC E07; Available from NTIS as TIB/B87-07041.

Translated from Russian.

Results from two-particle correlation studies are presented for π/sup 0/-mesons ejected in π/sup -/-Xe collisions at 3.5 GeV/c momentum. Interference correlations of π/sup 0/ mesons are found. Size of the region is determined, where the π/sup 0/ mesons are ejected from, and the π/sup 0/ generation time is estimated: r = 1.2 +- 0.3 fm, c/sub tau/ = 0.8 +- 0.4 fm. The results correspond to those obtained in hadron-hadron collisions but the values of r and c/sub tau/ are smaller than those for nucleus-nucleus collisions at such energies.

38256 **Observation of full sets of coexisting intruder excitations in the N=58 isotones and isotopes of Zr: Evidence for alpha correlated excitations.** Meyer, R.A.; Aprahamian, A.; Henry, E.A.; Mann, L.G.; Roy, N.; Lhersonneau, G.; Menzen, G.; Sistemich, K.; Heyde, K. (Lawrence Livermore National Lab., CA; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.; Ghent Rijksuniversiteit, Belgium). pp 45-46 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

## 6518 Nuclear Properties And Reactions, A=150-189, Experimental

38257 **Laboratory determination of the half-life of $^{187}$Re, a nuclide of cosmological interest.** Lindner, M.; Leich, D.A.; Borg, R.J.; Russ, G.P.; Bazan, J.M.; Simons, D.S.; Date, A.R. (Lawrence Livermore National Lab., CA; National Bureau of Standards, Gaithersburg, MD; British Geological Survey, London). pp 986 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—). Contract W-7405-ENG-48.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

38258 **Energy correlations of γ-rays from superdeformed states in Z=66 and 68 isotopes; multipolarities in $^{152}$Dy.** Voigt, M.J.A. de; Riezebos, H.; Klinken, J. van; Balanda, A.; Sujkowski, Z.; Bacelar, J.C.; Beck, E.M.; Deleplanque, M.A.; Diamond, R.M.; Stephens, F.S. (Rijksuniversiteit Groningen, Netherlands; Uniwersytet Jagiellonski, Krakow, Poland; Institute for Nuclear Studies, Swierk, Poland; Lawrence Berkeley Lab., CA). pp 116-121 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

38259 **Can the neutrino mass be measured using /sup 163/Ho electron capture.** Bennett, C.L. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 128-147 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985). Contract W-7405-ENG-48.

The safest limit on the neutrino mass comes from allowing the interference amplitude to be a free parameter in a fit to Springer's inner bremsstrahlung data while fixing the Q value to its

upper limit based on the results of the relative capture rates from F. Hartmann's data. Since /sup 163/Ho was the most promising electron capture candidate for a neutrino mass detector, it is unlikely that electron capture will ever compete with tritium beta decay in terms of sensitivity to neutrino mass. The best fundamental thing that can be said is that the limit of the difference in the mass of the neutrino and its anti-particle is smaller in absolute value than for any other fermion anti-fermion pair.

## 6519 Nuclear Properties And Reactions, A=190-219, Experimental

**38260 (GSI—87-7-Prepr.) Excitation energy sharing in / sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u.** Sohlbach, H.; Freiesleben, H.; Braun-Munzinger, P.; Kohlmeyer, B.; Marinescu, M.; Puehlhofer, F.; Schneider, W.F.W.; Schuell, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Bochum Univ. (Germany, F.R.). Inst. fuer Experimentalphysik; State Univ. of New York, Stony Brook (USA). Dept. of Physics; Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik). Jan 1987. 29p. NTIS, PC E07; Available from NTIS as TIB/B87-04776.

The average values and the fluctuations of the excitation energy sharing in quasielastic reactions are studied in two systems at various beam energies. The measured energy spectra of uniquely identified projectile-like nuclides reveal structures which are attributed to sequential decay of primary reaction products. The centroids and the widths of these structures can be reproduced consistently by means of a Monte Carlo simulation of sequential neutron emission within an isotopic chain only if the average value and the fluctuation of the excitation energy sharing are chosen properly for different reaction channels. Significant channel dependences of this energy sharing are observed for both systems and at all bombarding energies. The excitation energy is found to be allocated in both systems mainly to that fragment which picked up nucleons.

**38261 (LBL—23381) Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$.** Chan, Y.; Chavez, E.; Dacal, A.; Gazes, S.B.; Harmon, A.; Ortiz, M.E.; Plagnol, E.; Pouliot, J.; Stokstad, R.G. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 12p. (CONF-870177—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011213.

From 5. Oaxtepec nuclear physics symposium; Oaxtepec, Mexico (5 Jan 1987).

Reaction kinetics of incomplete fusion reactions between heavy nuclei of Oxygen and Uranium and Oxygen and Gold are studied at 32.5 MeV bombarding energy to gain information about linear momentum transfer. It is found that the most probable linear momentum transfer is only about 75% of the beam momentum for these reactions. Binary massive transfer mechanisms and prompt nucleon emission are offered as explanations of this phenomena. It appears that nuclear mean field dynamics rather than nucleon-nucleon phenomenon dominate reaction kinetics at this bombarding energy. 5 refs., 8 figs.

**38262 Ir(t-arrow-right,α)Os reaction and implications for tests of supersymmetries.** Cizewski, J.A.; Burke, D.G.; Brown, R.E.; Sunier, J.W. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 822-825(Aug 1987).

The (t-arrow-right,α) reactions have been studied on /sup 191,193/Ir targets. The analyzing power to the $2_3^+$ state in /sup 192/Os does not indicate single step d/sub 3/2/ proton transfer. Implications of this result for the theoretical interpretation of earlier (d,$^3$He) measurements in terms of supersymmetries are discussed.

**38263 Photon decay of giant resonances.** Bertrand, F.E.; Beene, J.R.; Halbert, M.L. (Oak Ridge National Lab., TN). pp 132-140 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—). Contract AC05-84OR21400.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

We have determined the total gamma-decay probability, the ground-state gamma branching ratio, and the branching ratios to a number of low-lying states as a function of excitation energy in $^{208}Pb$ to proportional to 15 MeV. The total yield of ground-state E2 gamma radiation in $^{208}Pb$ can only be understood if decay of compound states is considered. Other observations in $^{208}Pb$ include the absence of a significant branch from the giant quadrupole resonance (GQR) to the low-lying collective states at 2.6 MeV and 4.08 MeV, and a strong branch to a $3^-$ state at 4.97 MeV. 555 figures.

## 6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

**38264 Beta decay of neutron-rich transuranic nuclei.** Hoff, R.W. (Lawrence Livermore National Lab., CA). pp 207-212 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

## 6530 Nuclear Theory

*REFER ALSO TO CITATION(S) 38193, 38198, 38212, 38240, 38259, 38262*

**38265 (ANL-HEP-CP—87-45) Semi-inclusive inelastic electron scattering from nuclei.** Berger, E.L. (Argonne National Lab., IL (USA)). 30 Apr 1987. Contract W-31109-ENG-38. 29p. (CONF-870165—9). NTIS, PC A03/MF A01; GPO Dep. File Number DE87011484.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

A survey is presented of the physics of the electroproduction of hadrons from nuclear targets, eA → e'hX. Variables and structure functions are specified. The parton model description of electroproduction is summarized; fragmentation functions are defined and their properties are listed. Specific measurements are suggested. Predictions of the pion exchange model are presented for the nuclear dependence of eA → e'hX, including a discussion of the special subprocess eπ → e'π in which scattering occurs from the pion constituents of nuclei.

**38266 (CONF-8706142—1) An optical model analysis of $^{16}O$ + $^{12}C$ elastic scattering at E/A = 94 MeV.** Kobos, A.M.; Satchler, G.R. (Oak Ridge National Lab., TN (USA); Myrias Research Corp., Edmonton, Alberta (Canada)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010894.

From Supercomputing symposium; Calgary, Canada (15 Jun 1987).

An analysis of experimental data for $^{16}O$ + $^{12}C$ elastic scattering at an $^{16}O$ bombarding energy of 1503 MeV is presented, including the use of "model-independent" and "semi-model-independent" techniques. The data unambiguously indicate an optical potential whose real part is approximately 80 MeV deep in the interior, but which is more attractive in the surface region than that given by a folding model with a "realistic" nucleon-nucleon interaction. 6 refs., 3 figs., 1 tab.

**38267 (DOE/ER/05126—307) Nonperturbative extension of the light-front QCD.** Namyslowski, J.M. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jan 1987. Contract AS05-76ER05126. 43p. (ORO—5126-307). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007376.

An approximate account of the soft field fluctuations in hadrons is proposed in the framework of the light-front dynamics. Hadrons are considered as bound systems of constituent quarks and gluons which acquire running masses due to the interaction with soft fields. The lower bounds on the virtuality $p^2$ = p/sub μ/p/sup μ/ of the single hard particle give upper bounds on the quark and gluon masses: m/sub quark/(p) < 331 MeV, and m/sub gluon/(p)

< 493 MeV. The state of hadron with momentum P/sub $\mu$/ has virtuality $D_0 = M^2$ - P/sub $\mu$/P/sup $\mu$/, where M is the hadron mass. In the n-constituent state, each constituent has average virtuality $D_0/n$ which is bounded from below. This bound gives the upper bounds on the number n of constituents in the state with virtuality $D_0$: n/sub quark/ < absolute value of $D_0/(331\ MeV)^2$, n/sub gluon/ < absolute value of $D_0/(493\ MeV)^2$. For the hadron's bound state equation we find the n-body propagator and the irreducible kernels in terms of the Jacobi relativistic, relative momenta. 28 refs., 8 figs., 8 tabs.

38268 **(DOE/ER/40048—19-N7) Influence of six-quark bags on electron scattering.** Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). Jan 1987. Contract AC06-81ER40048. 4p. (CONF-870165—7). NTIS, PC A02. File Number DE87011082.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

Possible signatures of the presence of nuclear six-quark bags are discussed. 8 refs., 1 tab.

38269 **(DOE/ER/40048—20-N7) The EMC effect and related issues.** Jung, Hong; Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 14p. (CONF-8703136—3). NTIS, PC A02. File Number DE87011081.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

The nucleon (plus pion) explanation of the EMC effect is investigated, and shown to be reasonable. The subjects of dynamical rescaling and the related Drell-Yan process are also discussed.

38270 **(DOE/ER/40068—3) [Intermediate/high energy probes and the structure of nuclei]: Final report.** Vary, J.P. (Iowa State Univ. of Science and Technology, Ames (USA)). 10 Feb 1987. Contract AC02-82ER40068. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010248.

We propose to expand our efforts to develop a theoretical framework for the quark and gluon structure of nuclei. We will continue to refine the ingredients of our current model, the quark cluster model (QCM), and initiate an ambitious program in the non-perturbative solution of field theories. We propose to first solve non-trivial model field theories in the strong coupling regime using the discretized light front quantization (DLFQ) scheme of Pauli and Brodsky. The goal of these initial efforts will be to develop fast and accurate methods for taking the continuum limit as well as to elucidate the consequences of spontaneous symmetry breaking within the DLFQ method. Subsequent efforts will address QCD in low dimensionality with the purpose of extracting non-perturbative predictions for quark and gluon amplitudes in few baryon systems. Simultaneously with this new initiative we will continue to develop extensions and applications of the QCM. We propose to continue predicting phenomena to be observed in high energy particle-nucleus collisions that reflect the rearrangement of quarks and gluons in nuclei. We will analyze the data from the SLAC NE3 experiment to discover whether they confirm the QCM prediction of "steps" in the ratio of nuclear structure functions when Bjorken x exceeds unity. In another effort, we will perform a search for narrow resonances in electron-positron interactions high in the continuum using the Bethe-Salpeter equation. These resonances are speculated to account for the positron peaks seen in the GSI heavy-ion experiments. We will also complete our development of microscopic effective Hamiltonians for nuclei structure which include the explicit treatment of delta resonances. These effective Hamiltonians will be used in constrained mean field calculations to evaluate conditions for nuclei to undergo a transition from nucleon matter to delta matter. 61 refs.

38271 **(DOE/ER/40150—22) 35 years of electron scattering.** Walecka, J.D. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 13p. (CEBAF-PR—87-002; CONF-8610239—2). NTIS MF A01; 2; GPO Dep. File Number DE87008491.

From Symposium celebrating 35 years of electron scattering in nuclear and particle science; Urbana, IL, USA (23 Oct 1986).

Historical aspects of electron reaction physics are presented. The presently understood picture of nuclear structure and the electron-nucleus interactions are discussed within the framework of the standard model.

38272 **(DOE/ER/40150—23) Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility].** Walecka, J.D. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 11 Dec 1986. Contract AC05-84ER40150. 30p. (CEBAF-PR—87-003; CONF-861277—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008675.

From Parity violation workshop - CEBAF; Newport News, VA, USA (11 Dec 1986).

This paper discusses the use of electron scattering experiments for exploring parity violation in the nuclear domain. It is shown how such experiments can test the structure of strong interactions, the local gauge theory quantum chromodynamics based on color, and the unified gauge theory of electroweak interactions. 14 refs., 13 figs., 1 tab. (DWL)

38273 **(N—87-20813) Statistical analysis of secondary particle distributions in relativistic nucleus-nucleus collisions.** Mcguire, S.C. (Alabama A and M Univ., Normal (USA)). Mar 1987. 44p. (NASA-CR—4054; NAS—1.26:4054). NTIS, PC A03/MF A01.

The use is described of several statistical techniques to characterize structure in the angular distributions of secondary particles from nucleus-nucleus collisions in the energy range 24 to 61 GeV/nucleon. The objective of this work was to determine whether there are correlations between emitted particle intensity and angle that may be used to support the existence of the quark gluon plasma. The techniques include chi-square null hypothesis tests, the method of discrete Fourier transform analysis, and fluctuation analysis. We have also used the method of composite unit vectors to test for azimuthal asymmetry in a data set of 63 JACEE-3 events. Each method is presented in a manner that provides the reader with some practical detail regarding its application. Of those events with relatively high statistics, Fe approaches 0 at 55 GeV/nucleon was found to possess an azimuthal distribution with a highly non-random structure. No evidence of non-statistical fluctuations was found in the pseudo-rapidity distributions of the events studied. It is seen that the most effective application of these methods relies upon the availability of many events or single events that possess very high multiplicities.

38274 **(ORNL/TM—10219) Calculated neutron-induced cross sections for /sup 58,60/Ni from 1 to 20 MeV and comparisons with experiments.** Hetrick, D.M.; Fu, C.Y.; Larson, D.C. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 103p. (ENDF—344). NTIS, PC A06. File Number DE87011958.

Nuclear model codes were used to compute cross sections for neutron-induced reactions on both $^{58}$Ni and $^{60}$Ni for incident energies from 1 to 20 MeV. The input parameters for the model codes were determined through analysis of experimental data in this energy region. Discussion of the models used, the input data, the resulting calculations, extensive comparisons to measured data, and comparisons to the Evaluated Nuclear Data File (ENDF/B-V) for Ni (MAT 1328) are included in this report. 118 refs., 101 figs., 19 tabs.

38275 **Calculation of pair production by 10 and 20 MeV photons.** Wright, L.E.; Sud, K.K.; Kosik, D.W. (Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 2, 562-572(Aug 1987).

We present new techniques for calculating electron-positron pair production in the field of a fixed point charge in distorted-wave Born approximation which permits the evaluation of the Dirac-Coulomb radial matrix elements for lepton energies much greater than the electron rest mass, and for large angular momenta. Using these techniques, the pair production cross sections for 10 and 20 MeV photons on uranium (Z = 92) are evaluated and compared to the so-called "bridging formulae" which connect the low

energy ($\omega<5$ MeV) distorted-wave Born approximation results to the approximate results for high energy ($\omega>50$ MeV) obtained with the Sommerfeld-Maue approximation and to the experimental results.

**38276 Microscopic analysis of projectile excitation for /sup 18/O+/sup 64/Ni.** Van Verst, S.P.; Kemper, K.W.; Carr, J.A. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 628-632(Aug 1987).

A microscopic analysis of the inelastic scattering of /sup 18/O from /sup 64/Ni is presented. The real transition potential for the excitation of the first $2^+$ state in /sup 18/O for /sup 18/O is calculated from the double folding model using proton and neutron transition densities determined from new medium energy electron and proton scattering data. The longer radial tail of the real transition potential obtained using this neutron transition density describes correctly the amplitude of oscillations in the Coulomb-nuclear interference region of the $2^+$ cross section. Unfortunately, coupled channels calculations, employing real double folded and imaginary Woods-Saxon interaction potentials and including reorientation of the /sup 18/O $2^+$ state, still fail to reproduce the phase of the Coulomb-nuclear interference pattern observed in the data. The imaginary part of the interaction potential, as the only phenomenological term remaining in the analysis, is suggested to be responsible for this defect.

**38277 Coriolis interaction and variable reflection asymmetry in fission vibrational resonances.** Lynn, J.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 2, 671-680(Aug 1987).

A new analysis of the 720 keV gross resonance in the neutron-induced fission cross section of /sup 230/Th has been made. While confirming some of the main conclusions of earlier analyses (such as presence of a double-parity rotational band, suggesting an underlying vibrational mode in a tertiary well of the fission barrier), the new analysis explores additional features of the vibrational model, as well as employing new fission product angular distribution data and treating already available data in a different way. The new model and least squares analysis indicate strong evidence for Coriolis coupling of the K = 1/2 single-particle state and its coupled rotational motion with a K = (3/2 single-particle state and rotational band, probably lying at 930 keV neutron energy. There is also strong evidence that the opposite parity band in the 720 keV gross resonance, which is brought down by the reflection asymmetry in the tertiary potential energy well, is attenuated by a factor of about 3—5 by the fact that reflection asymmetry is not a property expected of the potential energy surface at the inner barrier containing the well.

**38278 Neutron capture resonances of /sup 152/Gd and /sup 154/Gd.** Macklin, R.L. (Oak Ridge National Lab., P.O. Box X, Building 6010, Oak Ridge, TN 37831-6354). *Nuclear Science and Engineering;* **95**: No. 4, 304-310(Apr 1987). Contract AC05-84OR21400.

Neutron resonance parameters were found for /sup 152/Gd up to 2700 eV. An average s-wave spacing D/sub o/ = (17.4 +- 1.0) eV and radiation width (58.6 +- 3.0) meV were found. The resonance contribution to the capture integral was found as (397 +- 32) n, exclusive of a 1/v term. Resonance parameters for /sup 154/Gd were extended from 490 to 2760 eV.

**38279 Global set of quadrupole deformation parameters for even-even nuclei.** Raman, S.; Nestor, C.W. Jr. (Oak Ridge National Lab., TN). pp 25-30 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

We have completed a compilation of experimental results for the reduced electric quadrupole transition probability [B(E2)arrow up] between the $0^+$ ground state and the first $2^+$ state in even-even nuclei. This compilation together with certain simple relationships noted by other authors can be used to make reasonable predictions of unmeasured B(E2)arrow up values. The quadrupole deformation parameter $\beta_2$ immediately follows, because $\beta_2$ is proportional to [B(E2)arrow up]$^{1}$2/. 555 figures.

**38280 Electromagnetic properties of nuclei at high spins.** Leander, G.A. (UNISOR, Oak Ridge, TN; Oak Ridge Associated Universities, Inc., TN). pp 79-87 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The purpose of this paper is a review of the E1, M1, and E2 properties of such highly excited states, in order to set the stage with theoretical props for the section on this topic in the present volume. This review does not aspire to completeness or a fair distribution of credit for past achievements, but does attempt to highlight the major current research topics in the field. 555 figures.

**38281 Evolution of nuclear structure with spin and temperature.** Khoo, T.L. (Argonne National Lab., IL). pp 98-105 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

In this talk the decay of the compound nucleus (CN) - from formation to ground state - will be described. The shape and nuclear structure evolution in this process will be traced, in which spin I and excitation energy E/sup */ decrease. Three topics will be discussed: (a) Shape relaxation following formation; (b) $\gamma$-decay towards the yrast line; and (c) $\gamma$-decay along the cold yrast line. 555 figures.

**38282 Massive lepton pair production - the Drell-Yan process - with nuclear targets.** Berger, E.L. (Argonne National Lab., IL). pp 374-381 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

In this paper I show that inclusive hadronic production of massive lepton pairs from nuclei, hA->(lanti l)X, will provide unique information on the nuclear (A) dependence of the quark and antiquark density distributions in nuclei. In Sec. II, the Drell-Yan model is reviewed briefly, with particular emphasis on nuclear effects. Proton induced reactions, pA->$\gamma$/sup */X, are treated in Sec. III; both pion and antiproton reactions are examined in Sec. IV. Conclusions are summarized in Sec. V. 555 figures.

**38283 Nuclear probes of fundamental symmetries.** Adelberger, E.G. (Washington Univ., Seattle). pp 592-602 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

Nuclei can be used in many ingenious studies of fundamental symmetries and my topic is so broad that it cannot be covered in a 30 minute talk. Hence I will restrict myself to giving an experimentalists quick overview of nuclear probes of three symmetries: isospin (I), parity (P) and time-reversal (T). I omit many currently active areas of research. Some of these (lepton nonconservation, neutrino masses and right-hand charged weak currents) are discussed elsewhere in this conference; others (such as axion searches) are not. 555 figures.

**38284 Proposal for a high sensitivity search for T-violation in slow neutron resonances.** Bowman, C.D.; Bowman, J.D.; Yuan, V.W. (Los Alamos National Lab., NM). pp 633-634 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

**38285 Supernovae and high density nuclear matter.** Kahana, S. (Brookhaven National Lab., Upton, NY). pp 938-949 of Weak and electromagnetic interactions in nuclei. Proceedings. Klapdor, H.V. (ed.). Berlin, Germany, F.R.; Springer (1986). (CONF-860741—).

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The role of the nuclear equation of state (EOS) in producing prompt supernova explosions is examined. Results of calculations of Baron, Cooperstein, and Kahana incorporating general relativity and a new high density EOS are presented, and the relevance of these calculations to laboratory experiments with heavy ions considered. 555 figures.

**38286 Symmetries in heavy nuclei and the proton-neutron interaction.** Casten, R.F. (Brookhaven National Lab., Upton, NY). pp 87-105 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract AC02-76CH00016.

The Interacting Boson Approximation (IBA) nuclear structure model can be expressed in terms of the U(6) group, and thereby leads to three dynamical symmetries (or group chains) corresponding to different nuclear coupling schemes and geometrical shapes. The status of the empirical evidence for these three symmetries is reviewed, along with brief comments on the possible existence of supersymmetries in nuclei. The relationships between these symmetries, the nuclear phase transitional regions linking them, and the residual proton-neutron interaction are discussed in terms of a particularly simple scheme for parameterizing the effects of that interaction. 34 references, 15 figures, 1 table.

**38287 Dynamical supersymmetric Diract Hamiltonians.** Ginocchio, J.N. (Los Alamos National Lab., NM). pp 175-183 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986).

Most recently a relativistic quantum mechanical approach to nuclear physics has proven promising. It is known, however, from the interacting boson model and the fermion dynamical symmetry model of nuclei that nuclear spectra exhibit dynamical symmetries. The author postulates that these symmetries perhaps have their basis in a relativistic theory particularly since the spin-orbit potential is a relativistic effect. In this regard he explores the Dirac Hamiltonian of a neutral fermion interacting with a tensor field in the language of QED. He first discusses a supersymmetry found for a general Dirac Hamiltonian of this type and then goes on to the special case of the Dirac Hamiltonian of a neutral fermion interacting via an anomalous magnetic moment in an electric potential. He demonstrates the square of this Hamiltonian to be equivalent to a three-dimensional supersymmetric Schroedinger equation. 15 references.

**38288 Empirical evidences for fermion dynamical symmetries in nuclei.** Wu, C.L. (Drexel Univ., Philadelphia, PA). pp 567-583 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986).

The similarities in symmetry between the fermion dynamical symmetries (FDS) model and the interacting boson model are evaluated. Empirical evidence which should allow the FDS model to stand on it own is then presented which shows that shell 7 and shell 8 possess SP(6) symmetry while shell 6 possesses SO(8) symmetry. For the nuclei with neutrons occupying shell 6 and protons occupying shell 5 the SO(8) symmetry is still preserved. Palladium isotopes 104-110 and ruthenium isotopes 98-104 are found to be good empirical realizations of the SO(7) subgroup chain in the SO(8) symmetry. This is the first example of a fermion dynamical symmetry in heavy nuclei that is not simply analogous to an established boson symmetry. Moreover, it is the first observed example of a symmetry that incorporates a variable structure applicable to nuclear transition regions. Its empirical verification is encouraging for the IBA and points toward a more fundamental origin for the observed symmetries of the latter. 16 references, 6 figures, 4 tables.

**38289 Space-time picture of relativistic propagation of medium energy hadrons through nuclei.** Bleszynski, M.; Jaroszewicz, T. (Physics Dept., UCLA, Los Angeles, CA 90024). pp 52-66 of Coherence, cooperation and fluctuations. Haake, F.; Narducci, L.M.; Walls, D.F. New York, NY; Cambridge University Press (1985). (CONF-8510395—).

From Symposium in honor of Roy J. Glauber, Harvard University: coherence, cooperation and fluctuations; Cambridge, MA, USA (19 Oct 1985).

Relativistic virtual pair creation effects in hadron-nucleus scattering at medium energies are discussed. A close analogy is found between these effects (particle propagation backwards in time) and some of noneikonal correlations to the Glauber theory, arising from particle propagation backwards in space. In multiple scattering both effects appear only for configurations involving overlapping scatterers and lead to the non-additivity of phase shifts. The proper-time path-integral formalism is found to provide an intuitive geometrical picture of these phenomena. The relativistic corrections are estimated to be of the order k/(aE/sup 2/), k being the particle momentum, E its energy, and a the target size. At medium energies they are comparable to noneikonal corrections, of order 1/(ak). Both effects vanish at high energy, when particle propagation in space-time can be described by means of geometrical optics.

**38290 Nuclear structure problems in double beta decay.** Haxton, W.C.; Stephenson, G.J. (Institute for Nuclear Theory, Univ. of Washington, Seattle, WA 98195). pp 148-155 of Neutrino mass and low energy weak interactions. Barger, V.; Cline, D. Teaneck, NJ; World Scientific Pub. Co. (1985).

The authors summarize some of the nuclear structure issues in theoretical treatments of $\beta\beta$ decay, emphasizing several of the less well-tested approximations commonly made.

## 6540 Radiation And Shielding Physics

*REFER ALSO TO CITATION(S) 36819, 37220, 38294*

**38291 (CONF-870405—10) New buildup factor data for point kernel calculations.** Trubey, D.K.; Harima, Y. (Oak Ridge National Lab., TN (USA); Tokyo Inst. of Tech. (Japan). Research Lab. of Nuclear Reactor). 1986. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000233.

From Radiation protection and shielding conference; Knoxville, TN, USA (22 Apr 1987).

An American Nuclear Society Standards Committee Working Group, identified as ANS-6.4.3, is developing a set of evaluated gamma-ray isotropic point-source buildup factors and attenuation coefficients for a standard reference data base. As a first step, a largely unpublished set of buildup factors calculated with the moments method has been evaluated by recalculating key values with Monte Carlo, integral transport, and discrete ordinates methods. Attention is being given to frequently-neglected processes such as bremsstrahlung and the effect of introducing a tissue phantom behind the shield. The proposed standard contains data for a source energy range from 15 keV to 15 MeV and for approximately 19 elements and 3 mixtures (water, air, and concrete). The data will also be represented as coefficients for the G-P fitting function. The 1985 data base was released as part of the CCC-493B/QAD-CGGP code package available from the Radiation Shielding Information Center (RSIC).

**38292 (DOE/ER/45160—1) Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report].** Batigun, C.M.; Brugger, R.M. (Missouri Univ., Columbia (USA). Research Reactor Facility). [1987]. Contract FG02-84ER45160. 21p. NTIS, PC A02. File Number DE87012077.

These experiments have observed the mirror reflection and Bragg diffraction of neutrons at the energy of a low lying nuclear resonance of $^{115}$In. The reflector was a mirror of In metal with the resonance at 1.457 eV. The mirror reflection for different angles of incidence has been measured and sets of data showing the relative

reflectivities have been obtained. For the Bragg diffraction, the crystal was a wafer of InP and several examples of Bragg reflections near 1.455 eV were measured. 4 refs., 12 figs.

## 6550 Medical Physics

*REFER ALSO TO CITATION(S) 37932*

## 6560 Condensed Matter Physics

*REFER ALSO TO CITATION(S) 37245, 38411*

**38293 (AD-A—179366/0/XAB) Angular-momentum theory applied to interactions in solids. Summary progress report.** Morrison, C.A. (Harry Diamond Labs., Adelphi, MD (USA)). Feb 1987. 164p. (HDL-SR—87-1). NTIS, PC A08/MF A01.

This report discusses those concepts of group theory that are applied to the spectra of impurity ions in crystals. Beginning with the simple hydrogen atom, spectroscopic notation and angular-momentum operators are discussed. This is followed by a general discussion of angular-momentum theory including Clebsch-Gordon coefficients, the Wigner-Eckart theorem, unit spherical tensors, and Racah coefficients. The extension of these techniques to the electronic configuration, (l to the Nth power), for N equivalent electrons is discussed. The theory of point groups as applied to ions in solids is introduced, along with the use of the International Tables of Crystallography and character tables. The phenomenological theory of crystal fields is discussed in some detail along with the so-called free-ion parameters characterizing the Coulomb interaction, the spin-orbit interaction, and the interconfiguration interaction. The use of tables of 3-j and 6-j symbols used in the calculation of the matrix elements of the various interactions is presented, along with other tables and aids in the computation of the energy levels. The point ion model of crystal-field interaction is discussed with particular emphasis on the work done at the Harry Diamond Laboratories (HDL) on its development. The earlier work at HDL was applied to triply ionized rare earth ions (l to the Nth power) electronic configuration), and the preliminary extensions presently being undertaken at HDL are applied to the transition-metal ions with the electronic configurations d to the Nth power (n=3,4, and 5).

**38294 (AD-A—179573/1/XAB) Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986.** Scully, M.O. (New Mexico Univ., Albuquerque (USA). Center for Advanced Studies). 1 Dec 1986. 119p. NTIS, PC A06/MF A01.

For a gas of simple atoms, it was found that a weak pulsed arbitrary transverse spatial dependence was prone to longitudinal propagation which was not affected by diffractive spreading. Progress was also made on the possibility of exchanging forbidden nuclear beta decay by exposure to radiofrequency fields. The interactions of charged particles in a laser field was also studied. Other areas of investigation included: 1) Internal conversion in an intense radiation field, 2) many-body and solid-state physics, 3) the role of laser amplitude fluctuations in nonlinear optical processes, and 4) atomic theory.

**38295 (BNL—39805) Artificial magnetic superlattices.** Majkrzak, C.F. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 22p. (CONF-870272—4). NTIS, PC A02. File Number DE87010753.

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

Neutron diffraction is an established method for studying long-range magnetic order in bulk condensed matter systems. Despite the comparatively small volumes of typical synthetic superlattice samples, neutrons can in fact be used to determine their microscopic magnetic structures as well. In particular, the magnetization profile along the modulation direction of a ferromagnetic thin film multilayer can be obtained from polarized neutron scattering measurements whether the films be amorphous or crystalline, provided that the superlattice periodicity is sufficiently well-defined. In addition to determining interfacial magnetic states and the effects of reduced dimensionality, inter-layer magnetic coupling can also be investigated. Actual neutron diffraction studies of magnetic superlattices are described as illustrative examples.

**38296 (CONF-870588—2) Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals.** Pellin, M.J.; Young, C.E.; Gruen, D.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011455.

From 20. annual scanning electron microscopy conference; Hamilton, Canada (3 May 1987).

Multiphoton ionization (MPI) by pulsed, tunable lasers provides a sensitive means for detection of neutral atoms. This resonant MPI technique can access all atomic states including ground and metastable levels. The MPI technique permits detailed sputtering data to be obtained with minimal target damage. Velocity and angular distributions can be obtained for each energy level of every sputtered species. Two types of experimental configuration have been employed. In one method, the photoionized atoms are allowed to strike a spatially resolved detector near the target, with extraction fields that preserve the angular distribution information. Velocity information is obtained by time-of-flight (TOF). This method is most suitable for majority species in the sputtered flux. In the case of minority species (either very dilute surface constituents or highly excited states produced), additional noise reduction is necessary. A suitable configuration involves extraction of the photoions into a sector-field TOF mass spectrometer. In standard, isochronous operation, energy and angular spreads at the point of ionization are compensated in flight to produce sharp TOF mass spectra. Noise sources (photons, metastable and scattered atoms) escaping through transparent grids are strongly suppressed. Angular distributions can be mapped. Velocity data can be obtained.

**38297 (DOE/ER/45135—17) Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986.** O'Connell, R.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1986. Contract FG05-84ER45135. 11p. NTIS, PC A02/MF A01. File Number DE87009448.

This final report gives brief descriptions of research in magneto-optical studies (with emphasis on Faraday rotation) of two-dimensional systems; the Wigner distribution function, which in general has been concerned both with the fundamentals and with applications to specific problems in two-dimensional systems; and a generalized quantum Langevin approach to heat-bath problems in condensed-matter physics (as well as to a variety of problems in other areas).

**38298 (LA—10989-T) An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux.** Hockaday, M.Y.P. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 252p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87010835.

The degradation of the x-ray reflection characteristics of metal multilayer Bragg diffractors due to intense x-ray flux was investigated. The Z-pinch plasma produced by PROTO II of Sandia National Laboratories, Albuquerque, New Mexico, was used as the source. The plasma generated total x-ray yields of as much as 40 kJ with up to 15 kJ in the neon hydrogen- and helium-like resonance lines in nominal 20-ns pulses. Molybdenum-carbon, palladium-carbon, and tungsten-carbon metal multilayers were placed at 15 and 150 cm from the plasma center. The multilayers were at nominal angles of 5° and 10° to diffract the neon resonance lines. The time-integrated x-ray reflection of the metal multilayers was monitored by x-ray film. A fluorescer-fiber optic-visible streak camera detector system was then used to monitor the time-resolved x-ray reflection characteristics of 135 A- 2d tungsten-carbon multilayers. A large specular component in the reflectivity prevented determination of the rocking curve of the multilayer. For a neon implosion onto a vanadium-doped polyacrylic acid foam target shot, detailed modeling was attempted. The spectral flux was determined with data from 5 XRD channels and deconvolved using the code SHAZAM. The observed decay in reflectivity was assumed to correspond to the melting of the first tungsten layer. A "conduction

factor" of 82 was required to manipulate the heat loading of the first tungsten layer such that the time of melting corresponded to the observed decay. The power at destruction was 141 MW/cm$^2$ and the integrated energy at destruction was 2.0 J/cm$^2$. 82 refs., 66 figs., 10 tabs.

38299 **(LBL—22991) Pulsed zero field NMR of solids and liquid crystals.** Thayer, A.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 347p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87011216.

This work describes the development and applications to solids and liquid crystals of zero field nuclear magnetic resonance (NMR) experiments with pulsed dc magnetic fields. Zero field NMR experiments are one approach for obtaining high resolution spectra of amorphous and polycrystalline materials which normally (in high field) display broad featureless spectra. The behavior of the spin system can be coherently manipulated and probed in zero field with dc magnetic field pulses which are employed in a similar manner to radiofrequency pulses in high field NMR experiments. Nematic phases of liquid crystalline systems are studied in order to observe the effects of the removal of an applied magnetic field on sample alignment and molecular order parameters. In nematic phases with positive and negative magnetic susceptibility anisotropies, a comparison between the forms of the spin interactions in high and low fields is made. High resolution zero field NMR spectra of unaligned smectic samples are also obtained and reflect the symmetry of the liquid crystalline environment. These experiments are a sensitive measure of the motionally induced asymmetry in biaxial phases. Homonuclear and heteronuclear solute spin systems are compared in the nematic and smectic phases. Nonaxially symmetric dipolar couplings are reported for several systems. The effects of residual fields in the presence of a non-zero asymmetry parameter are discussed theoretically and presented experimentally. Computer programs for simulations of these and other experimental results are also reported. 179 refs., 75 figs.

38300 **(SAND—86-2874) Modeling of shock-induced solid state chemistry.** Horie, Y.; Kipp, M.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011578.

This report, a sequel to Sandia Report 86-0922 entitled "Shock-Induced Solid State Chemistry: Theoretical Background" by Y. Horie, describes models of chemical reactions in inorganic powder mixtures under high pressure shock wave loading. In the present work, two mathematical models, one homogeneous and the other heterogeneous, were formulated based mostly upon existing results of observations on post-shock samples of Al-Ni, Al-Ti, and ZnO-$Fe_2O_3$ mixtures. Two basic mechanisms were isolated for the development of the initial models: (1) the creation of a nonequilibrium mixture by dynamic mass mixing, and (2) ensuing chemical reactions. The homogeneous model was evaluated under shock conditions using the one dimensional wave propagation code WONDY-V. We found that results of recent measurements can be rationalized by the model. The model also suggested requisite conditions for the thermal excursion of localized reactions: a localized initial peak temperature of 1000K to 2000K and reaction time constants of 1 μsec or less. Evidence that reactions occurred while the sample was under shock loading may also be rationalized by observations of post-shock samples.

38301 **(SAND—87-0765C) An analytical model for Rayleigh-Taylor instability in solids.** Robinson, A.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870753—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011064.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The model equations described in this paper are able to reproduce the qualitative behavior of the elastic-plastic Rayleigh-Taylor instability response seen in numerical experiments. Both elastic shear modulus and yield strength play important roles in the response characteristics. For low driving pressures a critical amplitude stability criterion may be appropriate. For sustained high pressure this rule will not be sufficient as there will exist wavelengths on the order of the plate thickness.

38302 **(UCID—21101) Molecular dynamics studies of energy transfer processes in crystal systems: Annual summary report.** Karo, A.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011899.

A two-dimensional model is presented for a nitromethyl radical which has been placed in a matrix of weakly-bound atoms three to four times heavier than the heaviest of the molecular atoms. The energy content of the molecule as a whole has been monitored as a function of time, as well as the energy flux into and out of specific bonds. This has been done for two cases, one in which the radical is embedded well within the lattice and a second where the radical is ejected from the lattice along with a sizeable amount of material. In addition, the energy flux was monitored for each molecular bond.

38303 **Density-of-states calculations within the recursion method.** Woodruff, D.M.; Anlage, S.M.; Smith, D.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 3, 1725-1734(15 Jul 1987).

We investigate methods to calculate projected density of states from a finite set of recursion coefficients. We consider tight-binding Hamiltonians describing the diamond-structure semiconductors α-Sn, Ge, Si, and C. Coefficients for about 110 levels of recursion are available for these Hamiltonians. Thus, we have coefficients for a sufficient number of recursion levels so that their asymptotic behavior is apparent. We first extrapolate the calculated coefficients using a linear predictive analysis suggested by Allan. This extrapolation is based on a perturbation theory that assumes that band gaps are small compared to the bandwidth. For α-Sn, Ge, and Si, which have band gap to bandwidth ratios (for the model Hamiltonians) of less than 0.05, the extrapolation procedure is found to be very successful. For C, however, with a band gap to bandwidth ratio of 0.106, large spurious features, which can be clearly associated with second-order perturbation terms, appear in the calculated density of states. We modify the extrapolation procedure using nonperturbative results for the asymptotic behavior of the recursion coefficients. The new extrapolation procedure gives good densities of states for C. Also, the calculated Green's function has the correct analytic structure.

38304 **Dielectric susceptibility of classical Coulomb systems. II.** Choquard, Ph.; Piller, B.; Rentsch, R. (Ecole Polytechnique Federale de Lausanne, Switzerland). *Journal of Statistical Physics;* **46**: No. 3/4, 599-633(Feb 1987).

This paper deals with the shape dependence of the dielectric susceptibility (equivalently defined, in a canonical ensemble, by the mean square fluctuation of the electric polarization or by the second moment of the charge-charge correlation function) of classical Coulomb systems. The concept of partial second moment is introduced with the aim of analyzing the contributions to the total susceptibility of pairs of particles of increasing separation. For a disk-shaped one-component plasma with coupling parameter $\gamma=2$ it is shown, numerically and algebraically for small and large systems, that (1) the correlation function of two particles close to the edge of the disk decays as the inverse of the square of their distance, and (2) the susceptibility is made up of a bulk contribution, which saturates rapidly toward the Stillinger-Lovett value, and of surface contribution, which varies on the scale of the disk diameter and is described by a new law called the arc sine law. It is also shown that electrostatics and statistical mechanics with shape-dependent thermodynamic limits are consistent for the same model in a strip geometry, whereas the Stillinger-Lovett sum rule is verified for a boundary-free geometry such as the surface of a sphere. Some results of extensive computer simulations of one- and two-component plasmas in circular and elliptic geometries are shown. Anisotropy effects on the susceptibilities are clearly demonstrated and the arc sine law for a circular plasma is well confirmed.

38305 **Quantum-resolved gas-surface scattering: NH/sub 3/ from Au (111).** Kay, B.D.; Raymond, T.D.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM 87185). pp 56-61 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract AC04-76DP00789.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WE2.

The authors measured angular, velocity, and quantum-state distributions for ammonia molecules scattered from a gold (111) single crystal for a number of surface temperatures and incident beam energies. A molecular beam source produces a well-collimated, rotationally cold (—15 K) beam of NH/sub 3/ molecules with a narrow dispersion of translational energy (—10%). The molecular beam impinges on an atomically clean, single crystal of gold (111) and the scattered NH/sub 3/ is detected in a quantum-resolved manner using two-photon resonant, three-photon ionization. The scattered angular distributions are sharply peaked about the specular angle, in contrast to the broad distributions observed in our earlier studies of NH/sub 3/ scattering from NH/sub 3/-saturated W (100). The final velocity distributions indicate a non-equilibrated mean translational energy, which is highly dependent on the incident beam kinetic energy. The mean scattered energy is up to five times that expected if this degree of freedom were fully accommodated with the surface.

## 6561 Superconductivity

*REFER ALSO TO CITATION(S) 37212, 37255, 37283, 37288, 37290, 37291, 37294, 37305, 37337, 37338, 37359, 37389, 37408, 37458*

38306 **(LA-UR—87-2119) Heavy electron superconductivity: From 1K to 90K to ?.** Pethick, C.J.; Pines, D. (Illinois Univ., Urbana (USA). Dept. of Physics; Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-870682—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011749.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

This paper reviews the experimental results and physical arguments which led us to conclude that in heavy electron systems the physical mechanism responsible for superconductivity is an attractive interaction between the heavy electrons which results from the virtual exchange of antiferromagnetic f-electron moment fluctuations. In these systems, then, the superconductivity is of purely electronic origin; the phonon-induced interaction between electrons which leads to superconductivity in ordinary metals plays little or no role.

## 6570 Theoretical And Mathematical Physics

*REFER ALSO TO CITATION(S) 38088, 38089, 38304, 38322*

38307 **(AD-A—179510/3/XAB) Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis.** Strauss, J.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1987. 111p. (AFIT/GE/ENG—87M-5). NTIS, PC A06/MF A01.

An algorithm was specified for the hardware implementation of the numerical solution of the electromagnetic fields of an arbitrary current source. The algorithm, defined as the Vector Wave Equation (VWE), solves for the magnetic and electric fields, as well as the vector potential of a finite-length arbitrary current source. The specified algorithm was verified through FORTRAN simulation to produce results accurate to within 2 decimal places for a 500-subelement dipole. The VWE forms a model that is algorithmically symmetric with respect to the cartesian-coordinate system. As such, the VWE lends itself to highly parallel and concurrent computational techniques. This property of the algorithm makes it an excellent candidate for implementation by a Very High Speed Integrated Circuit (VHSIC) class processor. Investigation of a parallel, highly concurrent architectural implementation yielded preliminary results that computational savings of a factor of 3 and a throughput-rate increase of 5 orders of magnitude is attainable. This research has shown that an application-specific VHSIC-class processor array has sufficient computing power to support interactive calculation of a set of equations which solve for the magnetic and electric fields, as well as the vector potential of an arbitrarily current source.

38308 **(LBL—23578) Quantum chemical methods for massively parallel computers.** Colvin, M.E. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87012058.

For many years it has been recognized that fundamental physical constraints such as the speed of light will limit the ultimate speed of single processor computers to less than about three billion floating point operations per second. A way to avoid this limit is to harness together many processors to work on a single computation problem. The work described in this thesis represents a first step toward the development of a general system of parallel quantum chemistry programs. Parallel algorithms have been developed for several important quantum chemical techniques: integral evaluation, self consistent field calculation, integral transformation and second order Moller Plesset energy calculation. These algorithms have been implemented and tested on a 32 processor Intel Hypercube. The benchmark calculations indicate very good parallel performance for all of these algorithms. The most computationally complex step, the two electron integral transformation, exhibits nearly perfect parallel speedup. That is, when utilizing n processors, the execution speed is increased by a factor of n over the single processor implementation.

38309 **(SLAC-PUB—4257) Measurement by phase severance.** Noyes, H.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 3p. (CONF-870892—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010463.

From Symposium on the foundations of modern physics; Joensuu, Finland (6 Aug 1987).

It is claimed that the measurement process is more accurately described by "quasi-local phase severance" than by "wave function collapse". The approach starts from the observation that the usual route to quantum mechanics starting from the Hamilton-Jacobi equations throws away half the degrees of freedom, namely, the classical initial state parameters. To overcome this difficulty, the full set of Hamilton-Jacobi equations is interpreted as operator equations acting on a state vector. The measurement theory presented is based on the conventional S-matrix boundary condition of N/sub A/ free particles in the distant past and N/sub B/ free particles in the distant future and taking the usual free particle wave functions, multiplied by phase factors.

38310 **(SLAC-PUB—4259) On the discrete reconciliation of relativity and quantum mechanics.** Noyes, H.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 3p. (CONF-870293—1). NTIS, PC A02. File Number DE87010543.

From 26. Schladming winter school in particle physics; Schladming, Austria (17 Feb 1987).

A way is sketched to replace physics based on arbitrary units of mass, length, and time by counting in terms of these quantized values and to replace continuum mathematical physics by computer science. The consequences of such a discrete physics are summarized. These are obtained by postulating finiteness, discreteness, finite computability, absolute non-uniqueness, and additivity. (LEW)

38311 **On the role of density fluctuations in the entropy of a fluid.** Wallace, D.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 4, 2282-2284(15 Aug 1987).

The phase-space region occupied by a dense fluid is characterized by significant multiparticle correlations, and by small density fluctuations. On the basis of this characterization, a statistical-mechanical formula is constructed, to represent the entropy of an

equilibrium dense fluid. For the example of fluid sodium, the statistical entropy agrees well with the measured thermodynamic entropy.

38312 **Isynchronous motion in classical mechanics.** Osypowski, E.; Olsson, M.G. (Physics Department, University of Wisconsin-Marathon, Wausau, Wisconsin 54401). *American Journal of Physics;* **55**: No. 8, 720-725(Aug 1987).

Those oscillatory motions for which the period is independent of the total energy are investigated. There is only one corresponding symmetric potential, the quadratic potential of the simple harmonic motion but infinite classes of asymmetric potentials must be considered. Geometric and analytic requirements of isochronism are discussed and several specific examples are given.

38313 **Synthesis of digital holograms by direct binary search.** Seldowitz, M.A.; Allebach, J.P.; Sweeney, D.W. (Purdue University, School of Electrical Engineering, West Lafayette, Indiana 47907). *Applied Optics;* **26**: No. 14, 2788-2798(15 Jul 1987).

A new approach to the design of computer-generated holograms makes optimal use of the available device resolution. An iterative search algorithm minimizes an error criterion by directly manipulating the binary hologram and observing the effect on the desired reconstruction. Several measures of error and efficiency useful in assessing the optimality of digital holograms are defined. Methods for designing digital holograms that are based on projections and error diffusion are presented as established techniques for comparison to direct binary search.

38314 **Conformal invariance and torsion in general relativity.** Maluf, J.W. (Univ. of Rochester, NY). *General Relativity and Gravitation;* **19**: No. 1, 57-71(Jan 1987). Contract AC02-76ER13065.

The authors study a theory for gravity in which the linear connections are assumed to be arbitrary, except that they are restricted to satisfy the metric condition $\Delta/\text{sub}\ \mu/\ g/\text{sup}\ \lambda\ \nu/ = 0$. A scalar field is added to the theory, and a conformally invariant action integral, linear in the curvature tensor, is defined. The linear connections emerging from the variational principle contain torsion that is related to a propagating spin-1 vector field, identified as the electromagnetic gauge potential. They obtain a set of conformally invariant equations for the metric field, and conclude that Einstein's equations arise from a particular choice of gauge. Finally, spin-1/2 fields are introduced by means of the vierbein formalism, and the qualitative features of the theory are maintained.

38315 **Mysterious world of symmetry in physics.** Iachello, F. (Yale Univ., New Haven, CT). pp 1-17 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract AC02-76ER03074.

The author describes the various ways in which the concept of symmetry is used in physics today. Starting from the notion of symmetry in art, he discusses briefly its applications to physics.

38316 **Dynamic symmetries in scattering.** Iachello, F. (Yale Univ., New Haven, CT). pp 247-254 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract AC02-76ER03074.

The author discusses a recent suggestion that dynamic symmetries and spectrum generating algebras can be used to describe scattering problems. 12 references, 1 figure.

38317 **Are the Dirac strings harmless?.** Lipkin, H.J.; Peshkin, M. (Argonne National Lab., IL). pp 323-328 of Symmetries in science II. Gruber, B.; Lenczewski, R. (eds.). New York, NY; Plenum Press (1986). Contract W-31-109-ENG-38.

The authors explore the physics involved in the interaction of a magnetic charge with an external magnetic field due to electric currents by means of a simple soluble model which includes the variables of the source of the magnetic field. They find that when those variables are included in the dynamical theory, there is no difficulty. The Hamiltonian exists, the energy is conserved, and the equations of motion are correct. However, in the limit where the current is externally fixed, paradoxes arise which appear to have serious implications for local theories based on the Maxwell fields or the vector potentials. Those paradoxes can be avoided by introducing Dirac strings, but then the strings appear not to be physically harmless. They imply the existence of a topological winding number variable which would not be present for amonopole without a Diract string. 5 references.

38318 **The group velocity of short optical pulses.** Ackerhalt, J.R.; Drummond, P.D.; Eberly, J.H. (Group T-12, Los Alamos National Lab., Los Alamos, NM 87545). pp 104-114 of Coherence, cooperation and fluctuations. Haake, F.; Narducci, L.M.; Walls, D.F. New York, NY; Cambridge University Press (1985). (CONF-8510395—).

From Symposium in honor of Roy J. Glauber, Harvard University: coherence, cooperation and fluctuations; Cambridge, MA, USA (19 Oct 1985).

Slow-varying-envelope techniques, analogous to those pioneered by Glauber in early studies of high energy particle scattering, are also widely used in quantum optics. The authors review the application of these techniques to short optical pulse propagation. They point out that the usual phase and group velocities may be ill-defined if the medium of propagation contains atoms or molecules with far off-resonant and near-resonant dipole transitions that share a common level.

# 70 FUSION ENERGY

## 7001 Plasma Research

*REFER ALSO TO CITATION(S) 38298, 38371, 38373*

38319 **(AD-A—179527/7/XAB) Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 31 Dec 1985. 58p. NTIS, PC A04/MF A01.

Contents include: linear magnetized plasma response to an oblique electrostatic wave; limits of linear response of a Vlasov distribution; saturation and post-saturation behavior of the Alfven ion-cyclotron instability: a simulation study; stabilizing effects of finite-amplitude r-f waves on the interchange instability; effect of large amplitude perpendicularly-propagating rf waves on the interchange instability; numerical simulations of turbulent trapping in the weak beam plasma instability: study of the growth rates; planar magnetron discharge simulations; planar magnetron discharges: mechanisms for instability, and numerical study of equilibrium; ES2: an electrostatic 2-D bounded simulation code with injection and external circuit; and energy conserving reflection algorithm.

38320 **(BNL—39605) Some thoughts on the muon catalyzed fusion reactor.** Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 25p. (CONF-8609135—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010056.

From International symposium on muon-catalyzed fusion; Tokyo, Japan (1 Sep 1986).

The design of the muon catalyzed fusion reactor is discussed. Some of the engineering challenges and critical research areas such as $\pi^-$ meson transport, beam entry single crystal window and coherent x-ray for stripping the muon from $\alpha$ particle, are considered. In order to reduce the tritium inventory and neutron wall loading, use of the laser technique for manipulating the d-t mixture is considered. The heterogeneous d-t mixture using the droplet or jet is discussed. 39 refs., 6 figs.

38321 **(CONF-870570—9) Ion cyclotron emission calculations using a 2D full wave numerical code.** Batchelor, D.B.; Jaeger, E.F.; Colestock, P.L. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009119.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Measurement of radiation in the HF band due to cyclotron emission by energetic ions produced by fusion reactions or neutral beam injection promises to be a useful diagnostic on the large devices which are entering the reactor regime of operation. A number of complications make the modelling and interpretation of such measurements difficult using conventional geometrical optics methods. In particular, the long wavelength and lack of high directivity of antennas in this frequency regime make observation of a single path across the plasma into a viewing dump impractical. Pickup antennas effectively see the whole plasma and wall reflection effects are important. The 2D full wave ICHR code has been modified to calculate wave fields due to a distribution of energetic ions in tokamak geometry. The radiation is modeled as due to an ensemble of localized source currents distributed in space. The spatial structure of the coherent wave field is then calculated including cyclotron harmonic damping as compared to the usual procedure of incoherently summing powers of individual radiators. This method has the advantage that phase information from localized radiating currents is globally retained so the directivity of the pickup antennas is correctly represented. Also, standing waves and wall reflections are automatically included.

**38322 (CONF-8610280—1) Solution to workshop problem 6 (hollow sphere) in the shell approximation with EDDYNET-2D.** Turner, L.R. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004838.

From International workshop for eddy current code comparison; Tokyo, Japan (20 Oct 1986).

The problem of the hollow sphere in a sinusoidal field has been solved in the single shell approximation with the code EDDYNET. Solutions with three different meshes are compared among themselves and with axisymmetric solutions obtained by 2-D codes. Agreement is good for total current and for field at points outside the sphere. Agreement is fair for field at interior points, where the field results from near cancellation of applied and induced fields. Agreement is poor for power dissipation and for the field at points in or near the conducting shell. The limited agreement is to be expected in using a single shell to model a hollow sphere with thickness greater than one skin depth.

**38323 (CONF-8706119—1) Modification of tokamak ballooning stability boundaries by alpha populations.** Spong, D.A.; Sigmar, D.J.; Ramos, J.J. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jun 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010605.

From Workshop on alpha particle effects in ETR; Washington, DC, USA (15 Jun 1987).

For T/sub $\alpha$//T/sub i/ < 150 (where T/sub $\alpha$/ is the $\alpha$-mean energy and T/sub i/ the ion temperature) the trapped $\alpha$-precession resonance destabilizes the kinetic ballooning mode of the bulk plasma. Using a slowing down distribution and both circular and noncircular equilibrium models, the eigenfrequencies of the resonant ballooning integral equation are computed. One finds lower critical betas and a widening of the unstable region, particularly at higher electron temperature and for flat q, steep pressure profiles typical of ignited sawtoothing plasmas.

**38324 (DOE/ER/13449—T8) Enhancing the muon-catalyzed fusion yield.** Jones, S.E. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy). 1986. Contract FG02-85ER13449. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010969.

This paper discusses the process of muon-catalyzed fusion and the reactions involved in this process. The muon catalysis cycle has been described including the muon-catalysis cycling rate. The alpha sticking behavior has been investigated as a means of increasing fusion yields. The effects of density and temperature have also been studied as to fusion yield increase. (FI)

**38325 (DOE/ER/52127—12) An alpha loss-cone instability in the central cell of a tandem mirror reactor.** Ho, Shu Kay. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1987. Contract FG02-86ER52127. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87011044.

D-T fusion-born alpha particles are mirror-confined in the central cell of a tandem mirror reactor. The resulting anisotropic loss-cone distribution of the alpha particles in velocity space is capable of destabilizing low frequency plasma waves, thus affecting the energy balance in a tandem mirror plasma. The low frequency waves of a cold, cylindrical, sharp-boundary, D-T plasma are studied. Techniques have been developed to trace the wave propagation regions and search the wave eigenfrequencies. Three branches of waves are found, namely the Alfven, hybrid, and fast waves; but only the Alfven wave is destabilized by the alpha loss-cone instability. The modeling of the alpha distribution function for the linear and quasi-linear instability calculations is done by a diffusion-front method and a numerical finite difference method, respectively. Their validity is established by comparing them with a converged 80-term Legendre function expansion model of the alpha distribution. The growth rate of the instability is basically determined by the alpha number density, the loss-cone angle, and the polarization of the wave. These quantities are in turn mainly affected by the density and temperature of the plasma ions and electrons, the mirror ratio, and the plasma radius. 83 refs., 58 figs.

**38326 (DOE/ET/51013—206) Studies of the regime of improved particle and energy confinement following pellet injection into Alcator C.** Greenwald, M.; Besen, M.; Camacho, F.; Fiore, C.; Foord, M.; Gandy, R.; Gomez, C.; Granetz, R.; Gwinn, D.; Knowlton, S. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Nov 1986. Contract AC02-78ET51013. 20p. (PFC/CP—86-20; CONF-861106—27; IAEA-CN—47/A-III-1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010005.

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

Pellet fueling in Alcator C can result in a plasma regime in which both energy and particle confinement are dramatically improved. In this regime ion thermal losses (highly anomalous in gas fueled plasma) are reduced to approximately neo-classical values resulting in increased global energy confinement for high density discharges where ion losses are important. There is little or no change in electron thermal conductivity. The pellet fueled discharges exhibit peaked density profiles, which tends to confirm the importance of the eta/sub i/ parameters determining ion thermal diffusivity. At the same time, impurity particle transport is reduced to neo-classical levels leading to accumulation of impurities and strong peaking of impurity profiles. Confinement of the hydrogenic species in the discharges core is also increased. The modification of ion-thermal, central particle, and impurity transport are well correlated; there are no discharges where only one or two of these change. In the favorable transport regime, sawteeth are partially or completely suppressed. This is likely due to the strong peaking of low Z impurities which flatten the central current profile by increasing the plasma resistivity. Radiation does not play an important role in the power balance of these discharges. For plasmas in which the sawteeth are suppressed the improved confinement is sustained for the remainder of the discharge.

**38327 (DOE/ET/51013—218) Modeling of ICRH experiments in the Tara tandem mirror.** Myer, R.C.; Golovato, S.N. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 9p. (PFC/CP—87-6; CONF-870570—15). NTIS, PC A02. File Number DE87011033.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

The production and heating of the central cell plasma in Tara are provided by a slot antenna located on the midplane bump of the axial magnetic field profile. Slow ion cyclotron waves excited by the slot propagate down a magnetic beach to ion cyclotron resonance layers located on either side of the bump where the rf power is strongly damped by the ions. Two different theoretical models are being used to study the efficiency of coupling to slow waves in this configuration. Wave propagation models which are based on the infinite plasma dispersion relation for a cold plasma indicate that radially propagating left hand polarized slow waves are converted to right hand polarized fast waves at the Alfven resonance layer due to the radial density gradient. If this were to occur we would expect a lower coupling efficiency to the ions in

the plasma core. On the other hand, a nonlocal kinetic model of rf wave propagation in a nonuniform plasma slab indicates that a significant left hand component of the electric field extends beyond the Alfven resonance layer. Preliminary experimental measurements of the radial inductive field profile agree qualitatively with the predictions of the cold plasma model, however, there is insufficient data at this time to establish that a density limit for slow wave accessibility to the plasma core exists.

38328 **(DOE/ET/51013—221) Fast-wave transmission and reflection in ion-cyclotron heating.** Fuchs, V.; Lashmore-Davies, C.N.; Francis, G.; Ram, A.K.; Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1987. Contract AC02-78ET51013. 5p. (PFC/CP—87-9; CONF-870570—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011036.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A second-order differential equation for the ion-cyclotron fast wave propagating in a hot, two ion species plasma is obtained. The equation includes the effects of both minority fundamental and majority second harmonic cyclotron damping. The approximation is based upon replacing the coupling to the ion Bernstein wave by a modified propagation description of the fast wave. For the case of perpendicular propagation, the second order equation reduces to the Budden equation giving the well known transmission coefficient for both two ion hybrid and second harmonic resonance. The solutions of the second order equation as a function of n/sub parallel/ give transmission and reflection coefficients which agree very well with the results based on models using higher order differential equations.

38329 **(DOE/ET/53088—213) Effects of ballooning instability on tokamak confinement.** Fu, Guoyong; Van Dam, J.W. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 29p. (IFSR—213). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010764.

Using the ballooning mode transport model proposed by Connor, Taylor, and Turner (1984), the thermal conductivity induced by ideal ballooning instability is derived and compared to experimental observations from auxiliary-heated tokamaks. It is shown how this model can be improved by means of a finite-beta equilibrium and also applied to obtain a confinement scaling law for high-beta, purely ohmically heated tokamaks. Finally, this transport model is employed to find that tokamaks with supplemental stabilization, for example, due to gyroradius, energetic particle, or shaping effects, can self-consistently access the second stability regime at rather high heating power.

38330 **(DOE/ET/53088—254) Confinement of a self-stabilized tokamak under average magnetic well conditions.** Demchenko, V.V.; Fu, G.Y.; Van Dam, J.W. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 10p. (IFSR—254). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010765.

It is well known that the average favorable magnetic curvature of a tokamak is stabilizing with respect to pressure-driven magnetohydrodynamic instabilities at low beta and that self-stabilization occurs at finite beta in the so-called second stability regime. Here we self-consistently investigate how these two effects, viz., the mean magnetic well and the self-stabilization, influence the energy confinement time in a tokamak, using the ballooning mode transport model.

38331 **(DOE/ET/53088—275) Plasma current sustained by fusion charged particles in a field reversed configuration.** Berk, H.L.; Momota, H.; Tajima, T. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1987. Contract FG05-80ET53088. 79p. (IFSR—275). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010788.

The distribution of energetic charged particles generated by thermonuclear fusion reactions in a field reversed configuration (FRC) are studied analytically and numerically. A fraction of the charged fusion products escapes directly while the others are trapped to form a directed particle flow parallel to the plasma current. It is shown that the resultant current density produced by these fusion charged particles can be comparable to background plasma current density that produces the original field reversed configuration in a D-$^3$He reactor. Self-consistent equilibria arising from the currents of the background plasma and proton fusion products are constructed where the Larmor radius of the fusion product is of arbitrary size. Reactor relevant parameters are examined, such as how the fusion reactivity rate varies as a result of supporting the pressure associated with the fusion products. We also model the synchrotron emission from various pressure profiles and quantitatively show how synchrotron losses vary with different pressure profiles in an FRC configuration.

38332 **(DOE/ET/53088—276) Nonlinear dynamics of tearing modes in the reversed field pinch.** Holmes, J.A.; Carreras, B.A.; Diamond, P.H.; Lynch, V.E. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Oak Ridge National Lab., TN (USA)). May 1987. Contract FG05-80ET53088;AC05-84OR21400. 49p. (IFSR—276). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010766.

The results of investigations of nonlinear tearing-mode dynamics in reversed field pinch plasmas are described. The linear instabilities have poloidal mode number $m = 1$ and toroidal mode numbers $10 \leqq n \leqq 20$, and the resonant surfaces are therefore in the plasma core. The nonlinear dynamics result in dual cascade processes. The first process is a rapid $m = 1$ spectral broadening toward high n, with a simultaneous spreading of magnetic turbulence radially outward toward the field-reversal surface. Global $m = 0$ perturbations, which are driven to large amplitudes by the $m = 1$ instabilities, in turn trigger the $m = 1$ spectral broadening by back-coupling to the higher n. The second process is a cascade toward large m and is mediated by $m = 2$ modes. The $m = 2$ perturbations have the structure of localized, driven current sheets and nonlinearly stabilize the $m = 1$ modes by transferring $m = 1$ energy to small-scale dissipation. The calculated spectrum has many of the qualitative features observed in experiments. 13 refs., 21 figs., 1 tab.

38333 **(DOE/ET/53088—277) Orbit extension method for finding unstable orbits.** Chen, Q.; Meiss, J.D.; Percival, I.C. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Queen Mary Coll., London (UK). School of Mathematics). May 1987. Contract FG05-80ET53088. 28p. (IFSR—277). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010767.

The orbit extension method is a technique for building long orbits from shorter ones. Combined with Newton's method, it gives a powerful and efficient tool for finding various orbits of area-preserving twist maps on a cylinder. It is particularly valuable for unstable orbits. This method is developed and used to find two kinds of orbits: ordered periodic orbits and principal heteroclinic orbits between two resonances. Flux from one resonance to another is obtained as a by-product of the principal heteroclinic orbits.

38334 **(DOE/ET/53088—279) Low beta rigid mode stability criterion for an arbitrary Larmor radius plasma.** Berk, H.L.; Wong, H.V. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 34p. (IFSR—279). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010768.

The low beta flute interchange dispersion relation for rigid displacement perturbation of axisymmetric plasma equilibria with arbitrary Larmor radius particles and field line curvature, large compared to the plasma radius, is derived. The equilibrium particle orbits are characterized by two constants of motion, energy and angular momentum, and a third adiabatic invariant derived from the rapid radial motion. The Vlasov equation is integrated, assuming that the mode frequency, axial "bounce" frequency, and particle drift frequency are small compared to the cyclotron frequency, and it is demonstrated that the plasma response to a rigid perturbation has a universal character independent of Larmor radius. As a result the interchange instability is the same as that predicted from conventional MHD theory. However, a new prediction, more optimistic than earlier work, is found for the low density threshold of systems like Migma, which are disc-shaped, that is, the axial extent $\Delta z$

is less than the radial extent $r_0$. For $\Delta z/sub\ r_0/$ much less than 1, the stability criterion is determined by the total particle number. Whereas the older theory ($\Delta z/sub\ r_0/$ much greater than 1) predicted instability at about the densities achieved in actual Migma experiments, the present theory ($\Delta z/sub\ r_0/$ much less than 1) indicates that the experimental results were for plasmas with particle number below the interchange threshold.

**38335 (ENEA-RT-FUS—86-12) Calculations of total fusion power and spatial distribution of emissivity for a D-T thermal plasma. Part I.** Batistoni, P. (ENEA, Rome (Italy)). Mar 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752640.

The feasibility of a neutron emissivity profile monitor for NET (Next European Torus) is investigated by means of a Monte Carlo code that simulates the neutron emission of a burning plasma within the NET configuration and assuming an ideal neutron diagnostic tool (a set of five horizontal collimators). The numerical values are treated as experimental data which are analyzed and inverted with several procedures in order to obtain the emissivity profile and to evaluate the total fusion power. The results show that the multicollimator design assumed in this preliminary work is inadequate to achieve the required accuracy and to fit the theoretical profiles. Suggestions are given to improve the conceptual design of the profile monitor for NET.

**38336 (EUR—9618-Vol.2, pp 419-426) Linear helical-axis stellarator experiments.** Ribe, F.L.; Greenfield, C.M.; Hedin, E.R.; Koepke, M.E. 1985. NTIS (US Sales Only), PC A17/MF A01. File Number DE87751804. (CONF-8409392—Vol.2).

From IAEA technical committee meeting on plasma confinement and heating in stellarators; Schloss Ringberg, F.R. Germany (24 Sep 1984).

We report research on straight, helical-axis , high-beta stellarator. Plasma configurations are generated by a 90 kV, 16 kJ 3-meter $\theta$ pinch (the High Beta Q Machine). The object is to study equilibrium and stability of the linear Heliac and also the simpler 1 = 1 stellarator. Initial experimental results are reported.

**38337 (GA-A—18775) Polarization change of electron cyclotron waves by reflection.** Hsu, Jang-Yu; Moeller, C.P. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1987. Contract AC03-84ER53158. 7p. (CONF-870570—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009301.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Given that the wave numbers of X and O modes merges as they approach the plasma boundary, a pure mode reflected from the plasma by a cut off may excite both modes due to polarization change when it is reflected off the vacuum vessel wall since the tangential components of the electric field change sign. This may explain the good central heating in DIII-D ECH experiments in which the fundamental X-mode is launched from the low field side.

**38338 (IPP—III-117) Investigation of density fluctuations in the edge region of the divertor tokamak ASDEX.** Rudyj, A. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jan 1987. 105p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-07050.

Stochastic density fluctuations occur in the plasma edge in a frequency range up to some 100 kHz. In regions with a high enough neutral gas density they are visible as a fluctuating band structure. On the divertor tokamak ASDEX these fluctuations are examined with the aid of photomultipliers connected to a variable arrangement of 8 light conductors whose inputs are projected on the plasma surface in the midplane. The analogue signals are digitised and then evaluated by spectral and correlation analysis. Radial resolution is realized by optical observations of a neutral Li-beam. In the ohmic discharges the detected plasma light demonstrates smooth power density spectra decreasing continuously to the highest observed frequency of 30 kHz. The fluctuations are well correlated along the magnetic field lines; perpendicularly, the correlation length is about 1.5 cm. They move with nearly the electron drift velocity. The fluctuations in the observed frequency range are located radially outside of the separatrix and have their origin at the outer surface of the torus. Drift wave turbulence is probably responsible for these phemomena.

**38339 (KMSF-U—1566) Alcator pellet evaporation data and the classical flux limit parameter.** Mayer, F.J.; Parker, J.K. (KMS Fusion, Inc., Ann Arbor, MI (USA); Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 21 Feb 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010884.

The steady-state, spherically symmetric, evaporation theory of Cowie and McKee is applied to recent well characterized pellet evaporation experiments at Alcator. A best "fit" to both low density and high density plasmas is obtained with the flux-limit parameter, f = 1, which implies fully-saturated electron heat flow throughout the pellet evaporation.

**38340 (LA-UR—87-1544) High density Z pinch formed from a solid deuterium fiber.** Hammel, J.E.; Scudder, D.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870629—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010108.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Experiments in which 250 kA have been passed through a z-pinch column formed from a thin fiber of cryogenic solid deuterium have demonstrated unexpectedly stable behavior. It has been shown that it is possible to maintain a z pinch in near radial equilibrium while it is ohmically heated from 16°K to several hundred eV. These results have motivated an effort to increase the plasma current to 1 MA and above, giving the potential of producing reactor-relevant plasmas capable of significant thermonuclear burn. Such a megamp experiment has been designed, partially fabricated, and successfully tested with an existing generator.

**38341 (LA-UR—87-1561) Field-reversed configuration formation and confinement studies on the LSM device.** Siemon, R.E.; Barnes, G.A.; Chrien, R.E.; Hugrass, W.N.; Ito, Y.; Rej, D.J.; Tuszewski, M.; Wright, B. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870629—5). NTIS, PC A02. File Number DE87010110.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This report gives information concerning testing of the LSM upgrade of the FRX-C/T device. Results of plasma confinement experiments are given. (JDH)

**38342 (LBL—23299) Congruent reduction and mode conversion in 4-dimensional plasmas.** Friedland, L.; Kaufman, A.N. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 7p. (CONF-870570—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010263.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Standard eikonal theory reduces, to N=1, the order of the system of equations underlying wave propagation in inhomogeneous plasmas. The condition for this remarkable reducibility is that only one eigenvalue of the unreduced NxN dispersion matrix D(k,x) vanishes at a time. If, however, two or more eigenvalues of D become simultaneously small, the geometric optics reduction scheme becomes singular. These regions are associated with linear mode conversion, and are described by higher order systems. A new reduction scheme based on congruent transformations of D is developed, and it is shown that, in "degenerate" plasma regions, a partial reduction of order is possible. The method comprises a constructive step-by-step procedure, which, in the most frequent (doubly) degenerate case, yields a second order system, describing the pairwise mode conversion problems, the solution of which in general geometry has been found recently.

38343 **(N—87-21684) Plasma physics abstracts, 1 January - 31 December, 1986.** Gurnett, D.A.; Dangelo, N.; Goertz, C.K. (Iowa Univ., Iowa City (USA)). May 1987. 20p. (NASA-CR—180220; NAS—1.26:180220). NTIS, PC A02/MF A01.

Topics addressed include: ion-cyclotron waves; plasma waves; solar wind lithium releases; bow shock; Pi2 wave bursts; auroral kilometric radiation; ion energization; magnetic field corrections; electric fields; magnetospheric processes; electron acceleration; inner heliosphere; nightside auroral zone; computerized simulation; plasma wave turbulence; and magnetohydrodynamic waves in plasma sheets.

38344 **(PPPL—2368) Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/.** Redi, M.H.; Tang, W.M.; Efthimion, P.C.; Mikkelsen, D.R.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1987. Contract AC02-76CH03073. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010626.

Transport simulations of ohmically heated TFTR experiments with recently developed profile-consistent microinstability models for the anomalous thermal diffusivities, chi/sub e/ and chi/sub i/, give good agreement with experimental data. The steady-state temperature profiles and the total energy confinement times, tau/sub e/, were found to agree for each of the ohmic TFTR experiments simulated, including three high radiation cases and two plasmas fueled by pellet injection. Both collisional and collisionless models are tested. The trapped-electron drift wave microinstability model results are consistent with the thermal confinement of large plasma ohmic experiments on TFTR. We also find that transport due to the toroidal ion temperature gradient (eta/sub i/) modes can cause saturation in tau/sub E/ at the highest densities comparable to that observed on TFTR and equivalent to a neoclassical anomaly factor of 3. Predictions based on stabilized eta/sub i/-mode-driven ion transport are found to be in agreement with the enhanced global energy confinement times for pellet-fueled plasmas. 33 refs., 26 figs., 4 tabs.

38345 **(PPPL—2400) An algorithm for the calculation of 3-D ICRF [Ion Cyclotron Range of Frequencies] fields in tokamak geometry.** Smithe, D.N.; Colestock, P.L.; Kashuba, R.J.; Kammash, T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010627.

A computational scheme is developed which permits tractable calculation of three-dimensional full-wave solutions to the Maxwell-Vlasov equations under typical Ion Cyclotron Range of Frequencies (ICRF) experimental conditions. The method is unique in that power deposition to the plasma is determined via the anti-Hermitian part of a truncated warm-plasma dielectric operator, rather than as the result of an assumed phenomenological collision frequency. The resulting computer code allows arbitrary variation of density, temperature, magnetic field, and minority concentration in the poloidal plane by performing a convolution of poloidal modes to produce a coupled system of differential equations in the radial variable. By assuming no inhomogeneity along the toroidal axis, an inverse transform over k/sub parallel/ is performed to yield the full three-dimensional field solutions. The application of the code to TFTR-like plasmas shows a mild resonance structure in antenna loading related to the changing number of wavelengths between antenna and the resonance layer. 48 figs.

38346 **(PPPL—2402) Tokamak physics studies using x-ray diagnostic methods.** Hill, K.W.; Bitter, M.; von Goeler, S.; Beiersdorfer, P.; Fredrickson, E.; Hsuan, H.; McGuire, K.; Sauthoff, N.R.; Sesnic, S.; Stevens, J.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1987. Contract AC02-76CH03073. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010628.

X-ray diagnostic measurements have been used in a number of experiments to improve our understanding of important tokamak physics issues. The impurity content in TFTR plasmas, its sources and control have been clarified through soft x-ray pulse-height analysis (PHA) measurements. The dependence of intrinsic impurity concentrations and Z/sub eff/ on electron density, plasma current, limiter material and conditioning, and neutral-beam power have shown that the limiter is an important source of metal impurities. Neoclassical-like impurity peaking following hydrogen pellet injection into Alcator C and a strong effect of impurities on sawtooth behavior were demonstrated by x-ray imaging (XIS) measurements. Rapid inward motion of impurities and continuation of $m = 1$ activity following an internal disruption were demonstrated with XIS measurements on PLT using injected aluminum to enhance the signals. Ion temperatures up to 12 keV and a toroidal plasma rotation velocity up to $6 \times 10^5$ m/s have been measured by an x-ray crystal spectrometer (XCS) with up to 13 MW of 85-keV neutral-beam injection in TFTR. Precise wavelengths and relative intensities of x-ray lines in several helium-like ions and neon-like ions of silver have been measured in TFTR and PLT by the XCS. The data help to identify the important excitation processes predicted in atomic physics. Wavelengths of $n = 3$ to 2 silver lines of interest for x-ray lasers were measured, and precise instrument calibration techniques were developed. Electron thermal conductivity and sawtooth dynamics have been studied through XIS measurements on TFTR of heat-pulse propagation and compound sawteeth. A non-Maxwellian electron distribution function has been measured, and evidence of the Parail-Pogutse instability identified by hard x-ray PHA measurements on PLT during lower-hybrid current-drive experiments.

38347 **(PPPL—2419) High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics.** Schwob, J.L.; Wouters, A.W.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1987. Contract AC02-76CH03073. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010629.

A high-resolution, time-resolving soft X-ray multichannel spectrometer (SOXMOS) that permits the simultaneous measurement of emission in two different spectral ranges has been developed and tested extensively for tokamak plasma diagnostics. The basic instrument is a high-resolution, interferometrically adjusted, extreme grazing incidence Schwob-Fraenkel duochromator. The instrument is equipped with two multichannel detectors that are adjusted interferometrically and scan along the Rowland circle. Each consists of an $MgF_2$ coated, funneled microchannel plate, associated with a phosphor screen image intensifier that is coupled to a 1024-element photodiode array by a flexible fibrer optic conduit. The total wavelength coverage of the instrument is 5 to 340° A with a measured resolution (FWHM) of about 0.2 A when equipped with a 600 g/mm grating, and 5 to 85 A with a resolution of about 0.06 A using a 2400 g/mm grating. The simultaneous spectral coverage of each detector varies from 15 A at the short wavelength limit to 70 A at the long wavelength limit with the lower dispersion grating. The minimum read-out time for a full spectral portion is 17 ms, but several individual lines can be measured with 1 ms time resolution by selected pixel readout. Higher time resolution can be achieved by replacing one multichannel detector with a single channel electron multiplier detector. Examples of data from the PLT and TFTR tokamaks are presented to illustrate the instrument's versatility, high spectral resolution, and high signal-to-noise ratio even in the 10 A region. 44 refs., 20 figs.

38348 **(PPPL—2420) Ideal MHD stability properties of pressure-driven modes in low shear tokamaks.** Manickam, J.; Pomphrey, N.; Todd, A.M.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1987. Contract AC02-76CH03073. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010630.

The role of shear in determining the ideal MHD stability properties of tokamaks is discussed. In particular, we assess the effects of low shear within the plasma upon pressure-driven modes. The standard ballooning theory is shown to break down, as the shear is reduced and the growth rate is shown to be an oscillatory function of n, the toroidal mode number, treated as a continuous parameter. The oscillations are shown to depend on both the pressure and safety-factor profiles. When the shear is sufficiently weak, the oscillations can result in bands of unstable n values which are present even when the standard ballooning theory predicts complete stability. These instabilities are named "infernal modes." The occurrence of these instabilities at integer n is shown to be a sensi-

tive function of q-axis, raising the possibility of a sharp onset as plasma parameters evolve. 20 refs., 31 figs.

38349 **(PPPL—2422) Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence.** Krommes, J.A.; Smith, R.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010632.

A variational procedure, due originally to Howard and explored by Busse and others for self-consistent turbulence problems, is employed to determine rigorous upper bounds for the advection of a passive scalar through an inhomogeneous turbulent slab with arbitrary generalized Reynolds number R and Kubo number K. In the basic version of the method, the steady-state energy balance is used as a constraint; the resulting bound, though rigorous, is independent of K. A pedagogical reference model (one dimension, $K = \infty$) is described in detail; the bound compares favorably with the exact solution. The direct-interaction approximation is also worked out for this model; it is somewhat more accurate than the bound, but requires considerably more labor to solve. For the basic bound, a general formalism is presented for several dimensions, finite correlation length, and reasonably general boundary conditions. Part of the general method, in which a Green's function technique is employed, applies to self-consistent as well as to passive problems, and thereby generalizes previous results in the fluid literature. The formalism is extended for the first time to include time-dependent constraints, and a bound is deduced which explicitly depends on K and has the correct physical scalings in all regimes of R and K. Two applications from the theory of turbulent plasmas ae described: flux in velocity space, and test particle transport in stochastic magnetic fields. For the velocity space problem the simplest bound reproduces Dupree's original scaling for the strong turbulence diffusion coefficient. For the case of stochastic magnetic fields, the scaling of the bounds is described for the magnetic diffusion coefficient as well as for the particle diffusion coefficient in the so-called collisionless, fluid, and double-streaming regimes.

38350 **(PPPL—2424) Eigenmode analysis of compressional waves in the magnetosphere.** Cheng, C.Z.; Lin, C.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010633.

A field-aligned eigenode analysis of compressional Alfven instabilities has been performed for a two component anisotropic plasma in a dipole magnetic field. The eigenmode equations are derived from the gyrokinetic equations in the long wavelength (k rho $<$ 1) and low frequency ($\omega <$ $\omega$/sub b/) limits, where rho is the hot particle gyroradius and $\omega$/sub b/ is the hot particle bounce frequency. Two types of compressional instabilities are identified. One is the drift mirror mode which has an odd parity compressional magnetic component with respect to the magnetic equator. The other is the drift compressional mode with an even parity compressional magnetic component. For typical storm time plasma parameters neargeosynchronous orbit, the drift mirror mode is most unstable and the drift compressional mode is stable. The storm time compressional Pc 5 waves, observed by multiple satellites during November 14-15, 1979 [Takahashi et al., 1987], can be explained by the drift mirror instability.

38351 **(PPPL—2425) Energy confinement and profile consistency in TFTR.** Goldston, R.J.; Arunasalan, V.; Bell, M.G.; Bitter, M.; Blanchard, W.R.; Bretz, N.L.; Budny, R.; bush, C.E.; Callen, J.D.; Cohen, S.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010634.

A new regime of enhanced energy confinement has been observed on TFTR with neutral beam injection at low plasma current. It is characterized by extremely peaked electron density profiles and broad electron temperature profiles. The electron temperature profile shapes violate the concept of profile consistency in which T/sub e/(O)/$<$T/sub e/$>$/sub v/ is assumed to be a tightly constrained function of q/sub a/, but they are in good agreement with a form of profile consistency based on examining the temperature profile shape outside the plasma core. The enhanced confinement regime is only obtained with a highly degassed limiter; in discharges with gas-filled limiters convective losses are calculated to dominate the edge electron power balance. Consistent with the constraint of profile consistency, global confinement is degraded in these cases. The best heating results in the enhanced confinement regime are obtained with nearly balanced co- and counter-injection. Much of the difference between balanced and co-only injection can be explained on the basis of classically predicted effects associated with plasma rotation.

38352 **(PPPL—2427) Vectorizing and macrotasking Monte Carlo neutral particle algorithms.** Heifetz, D.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010635.

Monte Carlo algorithms for computing neutral particle transport in plasmas have been vectorized and macrotasked. The techniques used are directly applicable to Monte Carlo calculations of neutron and photon transport, and Monte Carlo integration schemes in general. A highly vectorized code was achieved by calculating test flight trajectories in loops over arrays of flight data, isolating the conditional branches to as few a number of loops as possible. A number of solutions are discussed to the problem of gaps appearing in the arrays due to completed flights, which impede vectorization. A simple and effective implementation of macrotasking is achieved by dividing the calculation of the test flight profile among several processors. A tree of random numbers is used to ensure reproducible results. The additional memory required for each task may preclude using a larger number of tasks. In future machines, the limit of macrotasking may be possible, with each test flight, and split test flight, being a separate task.

38353 **(PPPL—2431) Gyrokinetic particle simulation of ion temperature gradient drift instabilities.** Lee, W.W.; Tang, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010636.

Ion temperature gradient drift instabilities have been investigated using gyrokinetic particle simulation techniques for the purpose of identifying the mechanisms responsible for their nonlinear saturation as well as the associated anomalous transport. For simplicity, the simulation has been carried out in a shear-free slab geometry, where the background pressure gradient is held fixed in time to represent quasistatic profiles typical of tokamak discharges. It is found that the nonlinearly generated zero-frequency responses for the ion parallel momentum and pressure are the dominant mechanisms giving rise to saturation. This is supported by the excellent agreement between the simulation results and those obtained from mode coupling calculations.

38354 **(SFB—162-85-04-141) Kinetics of excitation and ionization of Be I in tokamak devices.** Stefanov, B.; Zarkova, L.; Bessenrodt-Weberpals, M.; Hackmann, J.; Uhlenbusch, J. (Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 162 - Plasmaphysik Bochum/Juelich; Duesseldorf Univ. (Germany, F.R.). Physikalisches Inst. - Lehrstuhl 2). Aug 1985. 21p. NTIS, PC E07; Available from NTIS as TIB/B87-06947.

Excitation and ionization of beryllium (Be) atoms sputtered from a Be-limiter and penetrating a tokamak discharge are investigated. Three models are considered: (a) ionization from the ground state neglecting excited states; (b) a five-level (2/sup 1/S, 2/sup 3/P, 2/sup 1/P, 3/sup 3/S, and 3/sup 1/S) model; (c) a simplified five-level model with strong collisional-radiative coupling between higher and lower levels. The results show a coincidence between models (b) and (c) in calculating the distributions of level populations along the minor radius of the torus. At distances larger than 1.3 cm from the limiter, the population of the metastable 2/sup 3/P level exceeds the ground state population. Therefore at large distances from the limiter the 332.1 nm line of Be I may happen to suit better the diagnostics of Be-impurities than the resonant 234.9 nm line.

38355 **(UCLA/PPG—1070) Ray tracing analysis of LH [lower hybrid] fast waves in CCT [Continuous Current Tokamak].** Mau, T.K.; Lai, K.F.; Taylor, R.J. (California Univ., Los Angeles (USA). Tokamak Fusion Lab.). May 1987. Contract FG03-86ER52130;FG03-86ER53225. 6p. (CONF-870570—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010296.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Lower hybrid fast wave field profiles have been measured in the CCT tokamak. These field maps exhibit characteristics of large n/sub parallel/ wave components, with n/sub perpendicular//n/sub parallel/ $\cong$ 1, and the wave energy appears to be heavily damped in the toroidal direction. We use a 3-D toroidal ray tracing code to study this wave behavior. The spectral filtering of the fast wave can be partially attributed to mode conversion to the slow wave for the low n/sub parallel/ components. In most parameter regimes, subsequent strong absorption of the converted slow wave via electron Landau and higher harmonic ion damping results.

38356 **(UCRL—94086) Direct implicit electromagnetic plasma simulation.** Hewett, D.W.; Langdon, A.B. (Lawrence Livermore National Lab., CA (USA)). 6 May 1986. Contract W-7405-ENG-48. 6p. (CONF-860515—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009603.

From EPS conference on computational physics - computing in plasma physics; Partenkirchen, F.R. Germany (13 May 1986).

The essence of any implicit PIC (particle-in-cell) algorithm is to use part of the future fields in the evolution of the particle/field equations so that stability with a large time step can be maintained. The big impediment in developing implicit methods for PIC techniques has been the difficulty of solving the field rapidly and robustly in the parameter regimes of general interest. We describe here a new implementation of the Direct Implicit algorithm with a field solution that greatly reduces these concerns.

38357 **Measurement of the local particle diffusion coefficient in a magnetized plasma.** Levinton, F.M.; Meyerhofer, D.D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 8, 1393-1400(Aug 1987).

Local impurity particle diffusion coefficients have been measured in a low temperature plasma by the injection of test particles at the center of the plasma. The injection is accomplished by a high-voltage discharge between two small graphite electrodes on a probe. The probe can be located anywhere in the plasma. The diffusion is observed spectroscopically. An analysis of the spatial and temporal evolution of the C II radiation from the carbon discharge can determine the parallel and perpendicular diffusion of the impurity ions. Results with the diagnostic have been obtained in the Proto S-1/C spheromak. The measured value of the diffusion coefficient in the afterglow plasma is in good agreement with classical predictions.

38358 **Effect of trapped electrons on current drive.** Cohen, R.H. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **30**: No. 8, 2442-2449(Aug 1987). Contract W-7405-ENG-48.

Trapped-particle effects on electron—cyclotron resonance heating (ECRH) and lower-hybrid current drive are studied using the adjoint formalism. A square-well model for the collision operator is used to obtain an analytic form for the Green's function that is shown to be quite accurate. In constructing the current, the wave-heated distribution function is allowed to have an effective temperature along the velocity-space resonance curve that is different from the bulk temperature of the scattering electrons. These calculations are used to illustrate the deleterious effect of heating on the outside of a flux surface. Relativity and strong heating are each shown to increase current-drive efficiency for heating on the inside of the flux surface with Yequivalentharmonic number x cyclotron frequency/wave frequency less than 1, and decrease or reverse the driven current in the opposite limits. A significant limit on ECRH current drive in a mildly relativistic plasma, resulting from an upper bound on the minimum resonant energy, is demonstrated.

38359 **Anomalous current penetration and oscillating current drive in tokamaks.** Finn, J.M.; Antonsen T.M. Jr. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **30**: No. 8, 2450-2456(Aug 1987).

A current drive scheme for tokamaks, involving oscillating the Ohmic heating (OH) circuit, is proposed. This scheme is based upon the experimentally observed anomalous skin penetration during the start-up phase of tokamaks. Analytic and numerical results indicating feasibility are shown and scaling of steady-state current and power dissipated with frequency and plasma resistivity is presented. An explanation is given of why this scheme should work, in spite of the fact that the external circuit supplies no magnetic helicity. This scheme is potentially more efficient in terms of current generated per unit power dissipated than other current drive schemes. It is shown that a resistive magnetohydrodynamic (MHD) activity responsible for anomalous current penetration, and therefore required for the success of this current drive scheme, must be fully three dimensional. Finally, a comparison of the effectiveness of this scheme with that of F-$\Theta$ pumping in reversed-field pinches (RFP's) is presented.

38360 **Limits on the cross-field propagation of streams of cold plasma.** Borovsky, J.E. (Space Plasma Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 8, 2518-2526(Aug 1987).

When injected across an ambient magnetic field, a stream of collisionless plasma polarizes, and the resulting polarization electric field may allow the stream to penetrate the magnetic field. The polarization charge spreads from the stream sides along the magnetic-field lines and any ambient plasma that is magnetically connected to the stream will be picked up to form Alfven wings of co-moving plasma. As the stream and wing plasmas move across the magnetic field, their outer edges are continually stripped off. Because of these processes, the stream must expend charge, momentum, and kinetic energy in order to continue its cross-field motion. These expenditures derive from five requirements of charge from the stream: charge is required (1) to polarize the stream plasma, (2) to replace the charge stripped from the stream's edges as it propagates, (3) to set up the Alfven wings on the stream, (4) to replace the charge stripped from the sides of the wings as they propagate, and (5) to supply any conduction currents in the ambient plasma. By using idealized stream configurations, approximate limits on the propagation distance are obtained.

38361 **Plasma formation and equilibrium in a high $\beta$ tokamak.** Deniz, A.V.; Li, X.L.; Marshall, T.C. (Department of Applied Physics and Nuclear Engineering, Columbia University, New York, New York 10027). *Physics of Fluids;* **30**: No. 8, 2527-2537(Aug 1987).

The formation and equilibrium of a high $\beta$ tokamak in the Columbia High Beta Tokamak (HBT) (Plasma Physics and Controlled Nuclear Fusion Research 1986, in press) is documented using magnetic probes as the principle diagnostic. The formation from a toriodal field stabilized Z pinch is simulated with 2-D resistive magnetohydrodynamic (MHD) equations. From the measurement of the magnetic field by high-impedence internal magnetic probes, the poloidal flux, toroidal current, and safety factor are calculated. In addition, the plasma position and cross-sectional shape are determined. The tokamak has a major radius of about 0.24 m, a minor radius of about 0.05 m, and a toroidal current density of about $10^6$ A/m$^2$. The high $\beta$ tokamak plasma is observed to have an outward shift in major radius of both the magnetic center and the peak of the toroidal current density. The magnetic center moves inward in major radius after 20—30 $\mu$sec, presumably because the plasma maintains major radial equilibrium as its pressure decreases because of the radiation of impurity atoms.

38362 **Resistive-heating instability of a compressible, force-free plasma.** Sparks, L.; Van Hoven, G. (Department of Physics, University of California, Irvine, California 92717). *Physics of Fluids;* **30**: No. 8, 2470-2476(Aug 1987).

The thermal stability of a resistive, force-free plasma in a two-dimensional, slab geometry is investigated numerically. Linear-

ly unstable modes that arise as an energetic consequence of Ohmic heating are examined in relation to the dynamic magnetic-tearing instability. Plasma compression is found to give rise to a set of unstable thermal modes not seen in previous incompressible studies. Such modes can occur in parameter regimes where no purely growing tearing mode exists.

38363 **Symmetry properties of a multidimensional dispersion functional.** Schwarzmeier, J.L.; Barnes, D.C.; Lewis, H.R.; Seyler, C.E. (Los Alamos National Laboratory, MS-F642, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 8, 2414-2428(Aug 1987).

Symmetry properties are presented for a multidimensional dispersion functional. If the system of linearized Vlasov-field equations is "completely Hamiltonian," the dispersion operator satisfies a certain formal self-adjointness property as a function of omega. For appropriate boundary conditions this implies a relation between an eigenfunction and its dual. If the equilibrium admits "conjugate orbits" for a completely Hamiltonian system and if the "conjugate-orbit parity condition" is satisfied, then the kinetic part of the dispersion matrix is symmetric. For this case and for appropriate boundary conditions the entire dispersion matrix for the multispecies Vlasov or Vlasov-fluid models is symmetric. It then follows that the complex conjugate of the dual eigenfunction is proportional to the eigenfunction itself. The analytic continuation of the dispersion functional of the linearized Vlasov-field equations into the lower half of the frequency plane is derived.

38364 **Electron heating by ion acoustic turbulence in simulated low Mach number shocks.** Tokar, R.L.; Gary, S.P.; Quest, K.B. (Inertial Fusion and Plasma Theory, X-1, Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 8, 2569-2575(Aug 1987).

Explicit and fully electromagnetic particle-in-cell simulations of perpendicular, collisionless, and nominally subcritical shocks are performed in one and two spatial dimensions using the code w-smcapsa-smcapsVe-smcaps [Phys. Fluids 14, 830 (1971)]. Shock parameters are chosen to maximize the growth rates of the current driven ion acoustic instability in the shock. Electron heating by ion acoustic turbulence is observed at the shocks, at rates in agreement with second-order Vlasov theory predictions. However, the amount of resistive electron heating is small and ion reflection provides the major source of dissipation. Strictly resistive shocks do not exist for the parameters suitable for explicit particle codes running on today's supercomputers, because the plasma convects through these shocks so quickly that current driven instabilities have little time to be amplified and to heat the electrons resistively. This effect is primarily a result of the relatively small values of ω/sub p//sub e//ω/sub c//sub e/ that can be analyzed.

38365 **Observation of steepening in electron plasma waves driven by stimulated Raman backscattering.** Umstadter, D.; Williams, R.; Clayton, C.; Joshi, C. (University of California, Los Angeles, California 90024). *Physical Review Letters;* **59**: No. 3, 292-295(20 Jul 1987).

Harmonics of plasma waves excited by $CO_2$-laser—induced stimulated Raman scattering have been observed by frequency- and wave-number-resolved ruby Thomson scattering. Measurements of their relative amplitudes agreed with predictions of nonlinear warm-plasma wave-steepening theory up to the maximum observed amplitude of the fundamental component, n-italic-tilde$_1$/$n_0$ = 16%.

38366 **NOVA: A nonvariational code for solving the MHD stability of axisymmetric toroidal plasmas.** Cheng, C.Z.; Chance, M.S. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08544). *Journal of Computational Physics;* **71**: No. 1, 124-146(Jul 1987). Contract AC02-76CH03073.

A nonvariational approach for determining the ideal MHD stability of axisymmetric toroidal confinement systems is presented. The code (NOVA) employs cubic B-spline finite elements and Fourier expansion in a general flux coordinate (psi,$\theta$,$\xi$) system. At least as much accuracy and faster convergence were obtained in comparison with the existing variational PEST and ERATO codes which employ linear finite elements. This nonvariational approach benchmarked here on the ideal MHD problem is a prelude to a future extended version applicable to problems having non-Hermitian eigenmode equations were variational energy principles cannot be obtained. Copyright 1987 Academic Press, Inc.

38367 **Method and apparatus for maintaining equilibrium in a helical axis stellarator.** Reiman, A.; Boozer, A. (to Dept. of Energy, Washington, DC). US Patent 4,668,464. 26 May 1987. Filed date 31 Oct 1984. vp.

A method is described of maintaining three-dimensional MHD equilibrium of a plasma contained in a helical axis stellarator. The stellarator has a set of primary coils. The method comprises: providing a current through a resonant coil system about the stellarator. The resonant coil system has a configuration such that the current therethrough generates a magnetic field cancelling the resonant magnetic field, B/sub 1/, produced by currents driven by the plasma pressure at any given flux surface resonating with the rotational transform, chi, of another flux surface in the plasma; and varying the current as a function of $\beta$, where $\beta$=2p/sub o//B/sub o/2, p/sub o/ is the average plasma pressure, and B/sub o/ is the average stellarator magnetic field produced by the primary coils.

## 7002 Fusion Power Plant Technology

*REFER ALSO TO CITATION(S) 36819, 37302, 37486, 37518, 38326, 38336, 38341*

38368 **(CONF-870292—1-Vugraphs) Review of the Advanced Toroidal Facility program.** Lyon, J.F.; Murakami, M. (Oak Ridge National Lab., TN (USA)). 25 Feb 1987. Contract AC05-84OR21400. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007926.

From Magnetic Fusion Advisory Committee meeting; Atlanta, GA, USA (24 Feb 1987).

This report summarizes the history and design goals of the Advanced Toroidal Facility (ATF). The ATF is nearing completion at ORNL with device completion expected in May 1987 and first useful plasma operation in June/July 1987. ATF is a moderate-aspect-ratio torsatron, the world's largest stellarator facility with R = 2.1 m, $\alpha$ bar = 0.3 m and B = 2 T (5-s pulse) or 1 T (steady-state capability). It has been specifically designed to support the US tokamak program by studying important toroidal confinement issues in a similar magnetic geometry that allows external control of the magnetic configuration properties and their radial profiles: transform, shear, well depth, shaping, axis topology, etc. ATF will operate in a current-free model which allows separation of current-driven and pressure-driven plasma behavior. It also complements the world stellarator program in its magnetic configuration (between Heliotron-E and W VII-AS) and its capabilities (large size, good access, steady state capability, second stability access, etc.). For both roles ATF will require high-power long-pulse heating to carry out its physics goals since the high power NBI pulse is limited to 0.3 s. The ATF program focuses on demonstrating the principles of high-beta, steady-state operation in toroidal geometry through its study of: (1) scaling of beta limits with magnetic configuration properties and the plasma behavior in the second stability regime; (2) transport scaling at low collisionality and the role/control of electric field; (3) control of plasma density and impurities using divertors; (4) plasma heating with NBI, ECH, ICH, and plasma fueling with gas puffing and pellet injection; and (5) optimization of the magnetic configuration.

38369 **(CONF-870405—4-Vugraphs) One and two dimensional radiation analysis of the compact ignition tokamak.** Selcow, E.C. (Oak Ridge National Lab., TN (USA)). 22 Apr 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009686.

From Radiation protection and shielding conference; Knoxville, TN, USA (22 Apr 1987).

This report consists of a group of slides describing the compact ignition tokamak (CIT). Several drawings present the layout of the facility. Concerns about radiation effects are mentioned. (JDH)

38370 **(CONF-870422—5) Tritons and tritides as the solute and diffusing species in ceramic tritium breeders.** Fischer, A.K.; Johnson, C.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011523.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

Intragranular diffusion of tritium is an inherent participant in the process of releasing tritium from lithium-containing ceramics that are used to breed tritium in a fusion reactor. The nature of this transport is reviewed in terms of the understanding established for the mechanism of hydrogen migration in other oxides, namely, that the diffusing species is the proton and that it moves from oxide ion to oxide ion, thereby giving rise to apparent hydroxide migration. Analogously, the triton, transiently bonded to successive oxides and forming successive tritoxides, is taken to be the dominant migrating species in ceramic breeders. In addition, tritide becomes a significant participant at low oxygen activity. The relationship of tritons and tritides as the migrating species to the observed release of both reduced and oxidized forms can be understood in terms of the thermodynamic conditions that prevail. Mechanisms exist that can be proposed to rationalize the participation of these species.

38371 **(CONF-870570—12) Tests of a high-power folded waveguide coupler for ICRF heating.** Owens, T.L.; Chen, G.L.; Haste, G.R.; Ryan, P.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010390.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

A full-scale folded waveguide coupler has been fabricated which will provide information on power handling, impedance matching, and multipactor effects. The coupler dimensions are 30 X 60 X 300 cm. The cross section of the coupler is small enough that a phased pair of couplers could be placed in a single Tore Supra or TFTR port. A single coupler could be placed in a CIT-size port. A movable back plate allows frequency adjustment over the range 78 to 140 MHz. Impedance matching at the waveguide has been achieved using a movable coaxial transmission line feed. bench-top comparisons with loop antennas have been made. The folded waveguide coupler will be mounted on the Radio Frequency Test Facility for high-power tests up to 1.5 MW.

38372 **(CONF-870629—1) Pellet injector research at ORNL.** Schuresko, D.D.; Milora, S.L.; Combs, S.K.; Foster, C.A.; Fisher, P.W.; Argo, B.E.; Barber, G.C.; Foust, C.R.; Gethers, F.E.; Gouge, M.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010402.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Several advanced plasma fueling systems are under development at the Oak Ridge National Laboratory (ORNL) for present and future magnetic confinement devices. These include multishot and repeating pneumatic pellet injectors, centrifuge accelerators, electrothermal guns, a Tritium Proof-of-Principle experiment, and an ultrahigh velocity mass ablation driven accelerator. A new eight-shot pneumatic injector capable of delivering 3.0 mm, 3.5 mm, and 4.0 mm diameter pellets at speeds up to 1500 m/s into a single discharge has been commissioned recently on the Tokamak Fusion Test reactor. The so-called Deuterium Pellet Injector (DPI) is a prototype of a Tritium Pellet Injector (TPI) scheduled for use on TFTR in 1990. Construction of the TPI will be preceded by a test of tritium pellet fabrication and acceleration using a 4 mm bore "pipe gun" apparatus. A new repeating pneumatic pellet injector capable of 2.7 mm, 4 mm, and 6 mm operation is being installed on the Joint European Torus to be used in ORNL/JET collaborative pellet injection studies. A 1.5 m centrifuge injector is being developed for application on the Tore Supra experiment in 1988. The new device, which is a 50% upgrade of the prototype centrifuge used on D-III, features a pellet feed mechanism capable of producing variable-size pellets (1.5 to 3.0 mm diameter) optimally shaped to survive acceleration stresses. Accelerating pellets to velocities in excess of 2 km/s is being pursued through two new development undertakings. A hydrogen plasma electrothermal gun is operational at 2 km/s with 10 mg hydrogen pellets; this facility has recently been equipped with a pulsed power supply capable of delivering 1.7 kJ millisecond pulses to low impedence arc loads.

38373 **(CONF-870629—2) ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development.** Hoffman, D.J.; Baity, F.W.; Mayberry, M.J.; Swain, D.W. (Oak Ridge National Lab., TN (USA); GA Technologies, Inc., San Diego, CA (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. File Number DE87010393.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Low-power coupling tests have been carried out with a prototype ion cyclotron range of frequencies (ICRF) compact loop antenna on the DIII-D tokamak. Plasma load resistance values higher than originally calculated are measured in ohmic and L-mode, beam-heated plasmas. Load resistance decreases by a factor of ~2 in H-mode operation. When edge localized modes (ELMs) occur, the antenna loading increases transiently to several ohms. Results indicate that fast-wave ICRF antenna coupling characteristics are highly sensitive to changes in the edge plasma profiles associated with the H-mode regime.

38374 **(CONF-870629—3) Technology development of antennas for ion cyclotron heating experiments in fusion devices.** Swain, D.W.; Baity, F.W.; Bryan, W.E.; Hoffman, D.J.; Owens, T.L.; Yugo, J.J. (Oak Ridge National Lab., TN (USA); McDonnell Aircraft Co., St. Louis, MO (USA); TRW Space and Technology Group, Redondo Beach, CA (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. File Number DE87010373.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

Antennas are being designed, fabricated, and tested for TFTR and Tore Supra that will deliver 4 MW per port to the hot plasma. The antennas' designs are nearly complete; they are backed by the results of extensive modeling, analyses, and tests of electrical, thermal, and structural characteristics that were carried out during the design process. Conceptual design for an antenna for the Compact Ignition Torus (CIT) is underway; it will require significantly higher rf power densities.

38375 **(CONF-8703140—1-Vugraphs) Ignition physics study group support of the engineering test reactor program.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 24 Mar 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02. File Number DE87008790.

From Field task proposal agreement review meeting; Washington, DC, USA (24 Mar 1987).

This paper consists of a series of vugraphs concerning the Engineering Fast Reactor Program. Design goals for the reactor are discussed and presented graphically. (JDH)

38376 **(CONF-8705133—1-Vugraphs) The ignition physics study group supports the compact ignition tokamak and engineering test reactor programs.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009125.

From 1. meeting of the US-EC Fusion Bilateral Coordinating Committee; Brussels, Belgium (6 May 1987).

This report presents a collection of Vugraphs dealing with the Compact Ignition Tokamak (CIT) and the Engineering Test Reactor (ETR). The role of the Ignition Physics Study Group is defined. Several design goals are presented. (JDH)

38377 **(DOE/ER/52118—2) Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987.** Steiner, D.; Embrechts, M.J. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jun 1987. Contract FG02-85ER52118. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010960.

This status report describes activities in two task areas: the Titan Reversed-field-Pinch Reactor (RFPR) study and Engineering Test Reactor (ETR) studies. In the Titan study, an investigation has

been made of the integrated-blanket-coil concept. This paper describes the thermal hydraulics, wall loading, and divertor coil and fast wall design. The ETR studies have focused on breeding blanket/breeding shield design options. A description of water chemistry and corrosion effects is provided. Uncertainties in the calculational model for the dose and dose limit in the polyimide insulator are also expressed. (FI)

**38378 (EGG—2508) Fusion Safety Program annual report: Fiscal year 1986.** Holland, D.F.; Merrill, B.J.; Herring, J.S.; Piet, S.J.; Longhurst, G.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1987. Contract AC07-76ID01570. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010942.

This report summarizes the Fusion Safety Program's (FSP) major activities in fiscal year 1986. The Idaho National Engineering Laboratory (INEL) is the designated lead laboratory, and EG & G Idaho, Inc., is the prime contractor for FSP, which was initiated in 1979. Activities are conducted at the INEL and in participating facilities, including the Hanford Engineering Development Laboratory (HEDL), the Massachusetts Institute of Technology (MIT), and the University of Wisconsin. The technical areas covered in this report include tritium safety, activation product release, reactions involving lithium breeding materials, safety of fusion magnet systems, plasma disruption, risk assessment methodology, and computer code development for reactor transients. Contributions to the Technical Planning Activity (TPA) and the "white paper" study by the Environmental, Safety,and Economics Committee (ESECOM) are summarized. The report also includes a summary of the safety and environmental analysis and documentation performed by the INEL for the Compact Ignition Tokamak (CIT) design project.

**38379 (ENEA-RT-FUS—86-7) Contributions to the 14th symposium on fusion technology.** Andreani, R. (ENEA, Rome (Italy)). Feb 1987. 102p. (CONF-860917—). NTIS (US Sales Only), PC A06. File Number DE87752631.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The FTU (Frascati Tokamak Upgrade) aims to achieve high values of nt and temperature. High densities and confinement times should be reached by the use of high magnetic fields (8T) and reduced size and a strong lower hybrid additional heating (8 MW at 8 GHz) will be applied to raise plasma temperature. The main features of the machine are: liquid nitrogen cooling, to reduce power and energy consumption, flexibility in plasma current and position control, all stainless steel vacum chamber, liner and limiter stuctures. The machine is presently in an advanced construction stage. The new 250 MVA flywheel generator and few component parts are already in Frascati in the new buildings and the project team is pushing to keep the envisaged timing that should see the first operation of the machine at room temperature at the end of 1987.

**38380 (GA-A—18842) Enhanced particle flux control in a tokamak with a resonant helical divertor.** Evans, T.E.; deGrassie, J.S.; Jackson, G.L.; Ohyabu, N.; Karger, F.; Haas, G.; Wootton, A.J.; Gentle, K.W.; McCool, S.M.; Rowan, W.L. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC05-78ET53043;AC03-84ER53158. 12p. (CONF-870629—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010651.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

A series of experiments designed to demonstrate the efficacy of the Resonant Helical Divertor (RHD) concept in a tokamak have been completed. These proof-of-principle experiments utilized a small scoop limiter and a simple modular coil set to produce an m = 7, n = 2 RHD configuration for controlling the particle efflux and edge refueling rate in the Texas Experimental Tokamak (TEXT). The coils were designed to generate a quasi-ergodic edge layer using a few modes. Nevertheless at small perturbation levels intact islands are produced. The results clearly demonstrate greater flux control than had been expected for this simple RHD geometry. Conditions necessary for optimal particle collection are the scoop limiter at the o-point of a 7/2 magnetic island, a 4 kA current in the coils producing islands of ~1.0 cm full width, and helium discharges at high toroidal magnetic field (B/sub t/ = 2.8T). The neutral density within the scoop limiter head is increased by up to 500% and recycling on the front scoop face can be reduced as much as 80%. Under optimal collection conditions the central electron density is reduced by 20% indicating enhanced globall particle control. Experimental results and implications of cross-field particle diffusion are presented. A comparison of RHD efficiencies in hydrogen and helium discharges is discussed.

**38381 (KFK—4165) Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. April 1986-September 1986.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Nov 1986. 80p. (EUR—10534e). NTIS, PC E09; Available from NTIS as TIB/B87-07049.

Nuclear fusion is one of the main activities of the Karlsruhe Nuclear Research Center (KfK). It is organized as a project under the Directorate of Reactor Development and Safety. The work of KfK concentrates on technology aspects of nuclear fusion with magnetic confinement. It is part of the European Fusion Programme where KfK participates as an association to EURATOM. Close links have been established to the Max Planck Institute for Plasma Physics (IPP). In the Entwicklungsgemeinschaft Kernfusion KfK and IPP cooperate for the development of future fusion experiments joining the experience gained in plasma physics (IPP) and materials, safety, and nuclear technology (KfK), respectively. As in the present strategy of the European Fusion Programme the Next European Tokamak (NET) is foreseen as the major next step, most of the activities of KfK address this subject. In addition to the contributions to NET, studies are carried out to innovate INTOR, the worldwide cooperation for an experimental reactor under the auspices of IAEA. Furthermore, the Entwicklungsgemeinschaft Kernfusion has evaluated the feasibility of a fusion reactor with a stellarator confinement.

**38382 (PPPL—2421) Impurity and particle transport and control in TFTR.** Hill, K.W.; Arunasalam, V.; Bell, M.G.; Bitter, M.; Blanchard, W.R.; Bretz, N.L.; Budny, R.; Bush, C.E.; Cohen, S.A.; Combs, S.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1987. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010631.

Degassing of the TFTR graphite limiter by low density deuterium or helium discharges enables the limiter to pump deuterium, thereby reducing recycling and improving energy confinement in neutral-beam-heated discharges. During a helium degassing sequence the hydrogen influx decreased by a factor of 20. As a consequence of degassing sequences the low density limit in 0.8 mA deuterium discharges decreased from 1 x $10^{19}$ $m^{-3}$ to 0.5 x $10^{19}$ $m^{-3}$, the density-decay time dropped from greater than 10 s to 0.15 s, and the recycling coefficient dropped from nearly 1 to less than 0.4. Z/sub eff/ values in 2.2 MA L-mode discharges on the toroidal limiter with neutral-beam-heating power up to 15 MW are between 2 and 3 if the pre-beam plasma has low Z/sub eff/ (high density), but can be as high as 4.5 if the pre-beam target has high Z/sub eff/ (low density). Z/sub eff/ values in enhanced confinement shots drop from 7 during the ohmic phase to 3 with neutral beam heating. The radiated power drops from 60 to 70% of total heating power to 30 to 35% for beam powers from 10 to 20 MW.

**38383 (UCRL—92353) Important atomic physics issues for ion beam fusion.** Bangerter, R.O. (Lawrence Livermore National Lab., CA (USA)). 19 Mar 1985. Contract W-7405-ENG-48. 9p. (CONF-8509397—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008755.

From 2. international workshop on atomic physics for ion fusion; Appleton, UK (11 Sep 1985).

This paper suggests several current atomic physics questions important to ion beam fusion. Among the topics discussed are beam transport, beam-target interaction, and reactor design. The major part of the report is discussion concerning areas of research necessary to better understand beam-target interactions. (JDH)

38384 **(UCRL—93569-Rev.1) Near spherical illumination of ion-beam and laser targets.** Mark, J.W.K. (Lawrence Livermore National Lab., CA (USA)). 12 Dec 1985. Contract W-7405-ENG-48. 18p. (CONF-8611161—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008483.

From American Physical Society meeting; San Diego, CA, USA (4 Nov 1986).

A procedure is developed for reducing energy-deposition asymmetry in spherical targets driven directly by ion or laser beams. This work is part of a strategy for achieving illumination symmetry in such targets, which is proposed as an alternative to those in the literature. This strategy allows an axially symmetric placement of beamlets, which would be convenient for some driven or reactor scenarios. It also allows the use of beam currents or energy fluxes and beam transverse profiles to help reduce deposition asymmetry with fewer beamlets. In the ideal limit of thin deposition layers and controlled beam profiles, at most six beamlets are needed for target symmetry.

38385 **(UCRL—94346-Rev.1) Symmetry issues in a class of ion beam targets using sufficiently short direct drive pulses.** Mark, J.W.K.; Lindl, J.D. (Lawrence Livermore National Lab., CA (USA)). 23 Oct 1986. Contract W-7405-ENG-48. 10p. (CONF-8610285—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009607.

From Heavy ion fusion symposium; Washington, DC, USA (1 Oct 1986).

Controlling asymmetries in direct drive ion beam targets depends upon the ability to control the effects of residual target asymmetries after an appropriate illumination scheme has already been utilized. A class of modified ion beam targets where residual asymmetries are ameliorated is considered. The illumination scheme used is an axially symmetric one convenient for reactor designs. Residual asymmetries are controlled by limiting the radial motion of the radius R/sub dep/ of peak ion energy deposition. Limiting the motion of R/sub dep/ is achieved by lengthening the time scale t/sub s/ where changes in R/sub dep/ adversely affect asymmetries. In our example, t/sub s/ becomes longer than the duration $\Delta$t/sub D/ of the entire direct drive pulse train (t/sub s/ > $\Delta$t/sub D/).

38386 **Pellet injection on the ZT-40M reversed field pinch.** Watt, R.G.; Wurden, G.A.; Weber, P.G.; Buechl, K.; Spanos, E.K. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **58**: No. 8, 1401-1405(Aug 1987). Contract W-7405-ENG-36.

The four barrel pneumatic pellet injector originally used on the Alcator C tokamak at MIT has been reconfigured for use on the ZT-40M reversed field pinch (RFP) at Los Alamos National Laboratory. The lower temperature and density in this device require operation at velocities significantly lower than on Alcator. Allowing a 2-s warmup prior to firing the injector has enabled operation with pressures as low as 40 psig and velocities ranging as low as 200 m/s with $H_2$ pellets, without major cryostat modification. Initial injection experiments in the ZT-40M plasma have verified that pellet refueling is effective for density control, but the net particle inventory increase is less than might be expected based on simple models. Indications of nonoptimal penetration and curvature of the pellet trajectory, in addition to comparable time scales for particle confinement and pellet transit, may account for this.

38387 **On relativistic self focusing.** Lee, P.H.Y. (Los Alamos National Lab., NM, USA). *Laser and Particle Beams;* **5**: 15-25(Feb 1987).

Ponderomotive force initiated laser self focusing can be enhanced by relativistic electron motion in a laser plasma. The nonlinear refractive index due to relativistic effects is derived and it is found that relativistic self focusing becomes important for a 0.25 $\mu$m laser when the laser intensity exceeds $5 \times 10^{18}$ W/cm$^2$.

38388 **The migration and coalescence of tritium-induced helium bubbles during creep in nickel.** Mintz, J.M.; Sattler, M.L.; Mukherjee, A.K. (Sandia National Labs., Livermore, CA 94550). *Scripta Metallurgica;* **21**: No. 2, 191-196(Feb 1987).

Understanding the behavior of helium in fusion reactor materials continues to be of critical importance to reactor designers. Of particular concern is the deleterious effect of grain boundary helium bubbles on mechanical properties, especially the high temperature ductility, of stainless steels. Grain boundary helium bubbles larger than a "critical" size for vacancy absorption are believed to reduce ductility by acting as ready-made nuclei for creep cavities. Rapid growth of these cavities then leads to premature intergranular fracture. Freshly nucleated bubbles are typically, however, only a few nanometers in size and are too small for growth by vacancy absorption. The subcritical growth regime implied by these observations was the subject of the present investigation. High purity nickel, as a less complex "analog" of stainless steel, was chosen as the material. Grain boundary helium bubbles act as effective creep cavity nuclei after attaining critical size for growth by vacancy absorption.

38389 **Radiographic detection of 100 a thickness variations in 1-$\mu$m-thick coatings on submillimeter-diameter laser fusion targets.** Stupin, D.M. (Los Alamos National Lab., NM). pp 1485-1494 of Review of progress in quantitative nondestructive evaluation. Volume 6B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1987). (CONF-8608142—).

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1986).

The author has developed x-ray radiography to measure thickness variations of coatings on laser fusion targets. Their technique is based on measuring the variation in x-ray transmission through the targets. The simplest targets are hollow glass microshells or microballoons 100 to 500 $\mu$m in diameter that have several layers of metals or plastics 1 to 100 $\mu$m thick. Their goal is to examine these opaque coatings for thickness variations as small as 1% or 0.1%, depending on the type of defect. Using contact radiography they have obtained the desired sensitivity for concentric and elliptical defects of 1%. This percentage corresponds to thickness variations as small as 100 A in a 1-$\mu$m-thick coating. For warts and dimples, the desired sensitivity is a function of the area of the defect, and they are developing a system to detect 0.1% thickness variations that cover an area 10 $\mu$m by 10 $\mu$m.

38390 **Progress in light ion beam fusion research on PBFA II.** Cook, D.L.; Allshouse, G.O.; Bailey, J. (Sandia National Labs., Albuquerque, NM, USA). *Plasma Physics and Controlled Fusion;* **28**: No. 12B, 1921-1930(Dec 1986). (CONF-8606323—).

From 13. annual conference Plasma Physics Group of the Institute of Physics; Oxford, UK (26 Jun 1986).

PBFA II is a 100 TW pulsed power accelerator constructed at Sandia National Laboratories for use in the Light Ion Fusion Program. The objective of PBFA II is to accelerate and focus upon an inertial confinement fusion (ICF) target a lithium beam with sufficient energy, power, and power density to perform ignition scaling experiments. The technologies used in PBFA II include: (1) primary energy storage and compression with 6 MV, low-inductance Marx generators, (2) pulse forming in water-insulated, water-dielectric lines with self-closing water switches, (4) voltage addition in vacuum using self-magnetically-insulated biconic transmission lines, (5) inductive energy storage and pulse compression using a fast-opening plasma erosion switch, (6) beam formation using a magnetically-insulated ion diode, and (7) space-charge and current-neutralized beam propagation to the target in a gas-filled cell. The first multimodule shot was on December 11, 1985. The plans for PBFA II include development and demonstration of the pulse-shaping techniques which are necessary for high-gain target compressions. Following a modification of the accelerator which will probably include an "extraction" ion diode, a 4- to 5-meter plasma channel for beam bunching during propagation, and a target chamber located beneath the accelerator, temporally-shaped ion beam pulses will be available for pulse-shaped target experiments.

# 99 GENERAL AND MISCELLANEOUS

*REFER ALSO TO CITATION(S) 36750, 37593*

**38391 (DOE/CE/63492—T3) Energy related business development project: Final report.** (Maine Development Foundation, Augusta (USA)). 31 Mar 1987. Contract FG01-86CE63492. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012139.

This report describes the conclusions of the team of consultants engaged by the Kennebec Valley Community Action Program (KVCAP) to develop a business plan for a for-profit energy related business to be partially owned by interested Maine CAPs. The consulting team conducted a reconnaissance study of twelve alternative business concepts and subsequently recommended focusing on a residential remodeling and repair business that incorporated major elements of two of the twelve concepts studied. The remodeling/repair business was subjected to a thorough analysis which included a 600 respondent consumer market survey and three focus group market studies, an evaluation of successful operators in the business, and an analysis of future trends in the industry. The consulting team developed a business plan, or more accurately two integrated business plans, for a business that has a significant amount of risk.

**38392 (DOE/CE/63498—T1) Code name: Opportunity battery: Phases 1 and 2 of Department of Energy Business Plan.** Sniff, B. (Community Action Commission of Fayette County, Washington Court House, OH (USA)). 15 May 1986. Contract FG01-86CE63498. 44p. NTIS, PC A03. File Number DE87010785.

The following are part of this report: business plan for Tri-County heating, personnel policies for Tri-County heating, and preliminary business plan for Operation Battery, a battery reconditioning and recycling project. (DLC)

**38393 (DOE/ER—0146/2) Office of Basic Energy Sciences: 1986 summary report.** (USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences). Dec 1986. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005570.

This document describes the program of the DOE Office of Basic Energy Sciences, which is responsible for basic research in the scientific disciplines likely to contribute to long-term energy goals. The subprograms and facilities are discussed, along with an abbreviated budget summary and an outline of plans for the future. (DLC)

**38394 (DOE/MA—0271) Doing business with the Department of Energy.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Small and Disadvantaged Business Utilization). Apr 1987. 100p. H; 1; GPO Dep. File Number DE87012203.

Since our inception in October, 1977, we have often been asked how a small private concern goes about doing business with DOE. This guide is intended to answer that question by providing basic information and initial contacts for possible business opportunities.

**38395 (IFUSP-P—524) Spontaneous ideas about the speed of light.** Villani, A.; Pacca, J.L.A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1985. 14p. NTIS (US Sales Only), PC A02. File Number DE87900800.

The answers of a group of Physics graduate students to two problems on the speed of light are analyzed. The results seem to confirm the use of spontaneous ideas which are very similar to those which form the "spontaneous" kinematics proposed by E. Saltiel of the University of Paris VII. Some consequences related to the teaching of Physics and Special Relativity are discussed.

**38396 (LA-UR—87-2107) Vehicle tracking systems.** Schwalm, R.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870890—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011755.

From 3. annual Armed Forces Communications Electronics Association and exposition; Philadelphia, PA, USA (4 Aug 1987).

Several systems have been developed to accomplish vehicle location. The systems consist of three types: Dead Reckoning, Satellite, and LORAN C. If the information is to be sent back to a central location, some type of radiocommunication system is needed. One can use the existing voice radio or add a radio system just for transmitting the data.

**38397 (NP—7900834) National Register of research projects: Part 1, Natural sciences: Biological, medical and related sciences.** (Department of National Education, Pretoria (South Africa)). Jul 1986. 260p. (In Afrikaans and English). NTIS (US Sales Only), PC A12. File Number DE87900834.

This Register is intended to serve as a source of information on research which is being conducted in all fields (both natural and human sciences) in the Republic of South Africa. New and current research projects that were commenced or continued during 1985, on which information was received by the compilers until March 1986, are included, with the exception of confidential projects.

**38398 (SAND—87-0002C) Authentication codes that permit arbitration.** Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870255—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011860.

From 18. southeastern international conference on combinatorics: graph theory computing; Boca Raton, FL, USA (23 Feb 1987).

Objective of authentication is to detect attempted deceptions in a communications channel. Traditionally this has been restricted to providing the authorized receiver with a capability of detecting unauthentic messages. The known codes have all left open the possibility for either the transmitter to disavow a message that he actually sent to the receiver, i.e., an authentic message, or else for the receiver to falsely attribute a message of his own devising to the transmitter. Of course the party being deceived would know that he was the victim of a deception by the other, but would be unable to "prove" this to a third party. Ideally, authentication should provide a means to detect attempted deceptions by insiders (the transmitter or receiver) as well as outsiders (the opponent). It has been an open question of whether it was possible to devise authentication codes that would permit a third party, an arbiter, to decide (in probability) whether the transmitter or the receiver was cheating in the event of a dispute. We answer this question in that both permits the receiver to detect outsider deceptions, as well affirmative by first constructing an example of an authentication code as permitting a designated arbiter to detect insider deceptions and then by generalizing this construction to an infinite class of such codes.

**38399 (SAND—87-0800C) A natural taxonomy for digital information authentication schemes.** Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870833—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011861.

From Crypto '87; Santa Barbara, CA, USA (16 Aug 1987).

Purpose of the lengthy description of the various authentication problems and schemes given here was two-fold: first to persuade the reader that each of the three essential dichotomies is genuine and arises in real-world situations and secondly, by construction of solutions to show that these really are independent classifications of authentication schemes. A figure summarizes the resulting classification and provides one or more examples of schemes illustrating each basic class.

**38400 (UCID—21106) A study of Economy of Force: An analysis of varying the size of a main and secondary taskforce against a dynamic defense.** Mohney, E.V.; Wittlin, M.R. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012309.

Computer simulation of combat is used to compare outcomes of blue attacks which varied in the number of forces taken from the main taskforce and sent to taskforce two. Taskforce one's mission is modeled as a frontal assault on a static red defense. Taskforce two's mission is modeled as a blocking force against a red reinforcement. The comparisons indicate an advantage to using the minimum

number of forces for taskforce two's mission. This suggests the importance of using the principle of war, Economy of Force, when planning an attack with more than one mission.

## 9902 Mathematics And Computers

*REFER ALSO TO CITATION(S) 38109*

**38401 (AD-A—179071/6/XAB) Performance comparison of four state-of-the-art computer architectures. Master's thesis.** Lee, R.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 220p. (AFIT/GCS/ENG—86D-17). NTIS, PC A10/MF A01.

This study determined the relative performance trends of sequential, vector, and multiprocessor architectures solving computationally intense problems. The problem time complexity of sequential matrix multiplication and inversion algorithms on a Cyber 845, a Vax-11/785, and a Cray X-MP/12 were compared with parallelizations of the algorithms on an Intel Personal Supercomputer (iPSC). In addition, sequential and parallel sort algorithms were run on the Vax and iPSC, respectively. The implementations were run with a range of data sizes. The relative time complexities were determined by computing the factor of execution time increase in relation to the factor of data size increase. By analyzing the problem time complexity, the machine-specific influences on execution speed were partially accounted for, thus enabling generalizations to the corresponding architectural classes to be drawn. It was shown that the multiprocessor was the only architecture to allow a reduction in the problem time complexity, and speedups from vector operations were constant.

**38402 (AD-A—179303/3/XAB) Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987.** Penfield, P.; Dally, W.J.; Glasser, L.A.; Knight, T.F.; Leighton, F.T. (Massachusetts Inst. of Tech., Cambridge (USA). Microsystems Research Center). 31 Mar 1987. 84p. NTIS, PC A05/MF A01.

It is important to know how fast a rise time can be achieved, or at what frequencies unwanted oscillations might occur. A set of necessary and sufficient bounds are now possible, in the sense that every point in the s-plane can be easily discovered to be either a frequency at which oscillation cannot occur with any possible combination of components and ideal transformers, or else a point at which a circuit consisting of a few such components and ideal transformers can be made to oscillate. The inclusion of ideal transformers is necessary since otherwise generally only a finite or countable number of natural frequencies can be found. Many new results have been derived for parallel algorithms and complexity, such as a hypercube with a large number of faulty nodes can be used, with high probability, as another perfectly functioning hypercube of half the size, by using reconfiguration algorithms that are simple, fast, and require only local information. The design of a message-driven processor continues. It is now being realized that many different highly parallel architectures require roughly the same sort of processing node, one that can respond quickly (i.e., with low latency) to messages that may require execution of a few (say about ten) instructions. The processor being designed can be considered an experiment in unifying message passing and shared-memory architectures.

**38403 (AD-A—179384/3/XAB) Performance evaluation of parallel branch and bound search with the Intel IPSC (Intel Personal Supercomputer) hypercube computer. Master's thesis.** Mraz, R.T. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 202p. (AFIT/GCE/ENG—86D-2). NTIS, PC A10/MF A01.

With the recent availability of commercial parallel computers, researchers are examining new classes of problems for benefits from parallel processing. This report presents results of an investigation of the set of problems classified as search-intensive. The specific problems discussed in this report are the backtracking search method of the N-queens problem and the Least-Cost Branch and Bound search of deadline job scheduling. The object-oriented design methodology was used to map the problem into a parallel solution. While the initial design was good for a prototype, the best performance resulted from fine tuning the algorithms for a specific computer. The experiments of the N-queens and deadline job scheduling included an analysis of the computation time to first solution, the computation time to all solutions, the speedup over a VAX 11/785, and the load balance of the problem when using an Intel Personal SuperComputer(IPSC). The IPSC is a loosely couple multiprocessor system based on a hypercube architecture. Results are presented that compare the performance of the IPSC and VAX 11/785 for these classes of problems.

**38404 (AD-A—179407/2/XAB) Experiment in knowledge-based signal understanding using parallel architectures. Technical report.** Brown, H.D.; Schoen, E.; Delagi, B.A. (Stanford Univ., CA (USA). Dept. of Computer Science). Oct 1986. 42p. (STAN-CS—86-1136). NTIS, PC A03/MF A01.

This report documents an experiment investigating the potential of a parallel-computing architecture to enhance the performance of a knowledge-based signal-understanding system. The experiment consisted of implementing and evaluating an application encoded in a parallel programming extension of Lisp and executing on a simulated multiprocessor system. The chosen application for the experiment was a knowledge-based system for interpreting preprocessed, passively acquired radar emissions from aircraft. The application was implemented in an experimental concurrent, asynchronous object-oriented framework. This framework, in turn, relied on the services provided by the underlying hardware system. The hardware system for the experiment was a simulation of various-sized grids of processors with interprocessor communication via message passing. The experiment investigated the effects of various high-level control strategies on the quality of the problem solution, the speedup of the overall system performance as a function of the number of processors in the grid, and some of the issues in implementing and debugging a knowledge-based system on a message-passing multiprocessor system. This report describes the software and (simulated) hardware components of the experiment and present the qualitative and quantitative experimental results.

**38405 (AD-A—179474/2/XAB) Optimal partitioning and redundancy removal in computing partial sums. Technical report (Final) December 1985-January 1987.** Fam, A.T. (State Univ. of New York, Buffalo (USA)). Mar 1987. 29p. NTIS, PC A03/MF A01.

Two novel algorithms for simultaneous computation of a large number of partial sums are introduced, their performance assessed, and architectures for their implementation suggested. The direct computation of D operations are replaced by O(D/ log D). The new approach is based on a new concept of optimal partitioning and redundancy removal in arithmetic-intensive, high-throughput computing that is expected to be the basis of a new class of algorithms, which represent a departure from brute force parallel computation where inherent redundancy is not detected or removed.

**38406 (AD-A—179577/2/XAB) Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis.** Tasseff, T.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 119p. (AFIT/GCS/ENG—86D-10). NTIS, PC A06/MF A01.

The AFIT-ASD Cray System, a virtual communications capability from the AFIT School of Engineering to ASD's Cray computer, was studied, created, and evaluated. The SADT design, detailed design, and System program code are included in the study. A user enters the System's user command SENDCRAY which initiated the user's input file to the central AFIT host computer. The input file is then sent first to the Cyber, which is a front-end to the Cray, and then to the Cray itself where the input is processed. Output from the Cray is sent to the Cyber and then back to the AFIT central computer. Finally, the output, with an accompanying job log file, is transferred to the user at the originating AFIT host computer. The System uses a combination of 4.2 BSD UNIX, Cyber NOS, and Cray operating system commands, and

makes use of an AFIT Ethernet network and a VAX-UNIX/Cyber HASP/modem link. The System operates over a series of UNIX C-shell programs, most of which are executed automatically. The System provides the user with simple, error-free, and automatic access to the Cray, with the potential of improved turnaround time for compute-intensive jobs at AFIT.

38407 **(BNL—39876) An assessment of the graphics upgrade needs of technology policy: Office of Policy, Planning and Analysis.** Kydes, A.S. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011300.

This paper provides a review and assessment of the software and hardware upgrade needs of Technology Policy in the Office of Policy, Planning and Analysis (PE) of equipment previously provided to PE in support of ongoing model refinements/upgrades of the World Energy Models.

38408 **(FNAL-TM—1457) VMS software for the Jorway-411 interface.** Dorries, T.; Moore, C.; Pordes, R.; White, V. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 4p. (CONF-870552—17). NTIS, PC A02. File Number DE87011001.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

This report describes a Software Package used to access CAMAC through the Jorway-411 Interface, for use on VAX/VMS systems. The software can be used to access parallel and/or serial CAMAC branch highways, and multiple Jorways may be connected to the VAX UNIBUS or MicroVax QBUS. The software available includes a VAX/VMS device driver for the JORWAY-411 and support routines and programs that access the driver. The software is accompanied by extensive documentation.

38409 **(FNAL-TM—1458) List processing software for the LeCroy 1821 Segment Manager Interface.** Dorries, T.; Moore, C.; Pordes, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1987. Contract AC02-76CH03000. 4p. (CONF-870552—18). NTIS, PC A02. File Number DE87011000.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

Many experiments at Fermilab now include some FASTBUS electronics in their data readout. The software reported in this paper provides general support for the LeCroy 1821 interface. The list processing device drivers allow FASTBUS data to be read out efficiently into the Fermilab Computing Department supported data acquisition systems.

38410 **(FNAL-TM—1463) A multiple node software development environment.** Heinicke, P.; Nicinski, T.; Constanta-Fanourakis, P.; Petravick, D.; Pordes, R.; Ritchie, D.; White, V. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1987. Contract AC02-76CH03000. 7p. (CONF-870552—15). NTIS, PC A02. File Number DE87010995.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

Experimenters on over 30 DECnet nodes at Fermilab use software developed, distributed, and maintained by the Data Acquisition Software Group. A general methodology and set of tools have been developed to distribute, use and manage the software on different sites. The methodology and tools are of interest to any group developing and using software on multiple nodes.

38411 **(LBL—23259) Interactive software for simulation of high resolution TEM images.** Kilaas, R. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 29p. (CONF-870725—8). NTIS, PC A03. File Number DE87011090.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

A new highly interactive and user friendly software package for simulation and processing of high resolution transmission electron micrographs has been developed at the National Center for Electron Microscopy (NCEM) at the Lawrence Berkeley Laboratory. Designed to be used by scientific visitors to the Center, the software is completely menu driven from a graphics terminal with a mouse and requires little to no computer knowledge for proper usage. Although the software is written to ensure maximum performance using hardware available at the NCEM, hardware dependent code is kept in separate modules that are easily modified. The new software package combines an unparalleled ease of use with the latest theory in the field of simulation of high resolution transmission electron micrographs.

38412 **(SAND—87-1114C) Coupling boundary integral and finite element formulations for nonlinear halfspace problems.** Stern, M.; Taylor, L.M. (Texas Univ., Austin (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8704141—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010735.

From IUTAM symposium on advanced boundary element methods; San Antonio, TX, USA (13 Apr 1987).

In finite element applications involving static or quasistatic nonlinear inelastic response in unbounded regions, there is the question of how to truncate the region to be modeled and how to select appropriate boundary conditions to be imposed on the remote boundary. Typically such problems are modeled by placing the exterior boundary "far enough away" so that the effect of fixing the boundary does not significantly alter the stress and deformation in areas of interest. There are two drawbacks to this approach. First, there is always some effect no matter how far away the boundary is placed, which makes it difficult for the analyst to judge precisely how much effect his choice of the location of the boundary is having on the solution. The second and perhaps more important drawback is that the boundary must be placed so far away from regions of interest that an unnecessarily large number of elements must be used, which increases the computational cost of the analysis. A promising alternative is to use an exterior boundary integral representation to calculate a "boundary stiffness" for the exterior region which can then be coupled to the finite element formulation in the interior region. This boundary stiffness scheme has been implemented in two explicit finite element codes which are widely used at Sandia for plane and axisymmetric quasistatic finite element analyses: JAC which uses a conjugate gradient method in the iterative solution of the finite element equations, and SANCHO which relies on dynamic relaxation. In this report the boundary integral application is applied to halfspace problems and its numerical implementation is described.

38413 **Implementing distributed AI systems using MACE.** Gasser, L.; Braganza, C.; Herman, N. (Distributed Artificial Intelligence Group, Computer Science Dept., Univ. of Southern California, Los Angeles, CA 90089-0782). pp 315-320 of Proceedings of the third conference on artificial intelligence applications. Piscataway, NJ; IEEE Service Center (1987). (CONF-870258—).

From 3. IEEE conference on artificial intelligence applications; Orlando, FL, USA (22 Feb 1987).

This paper describes the experimental DAI development system MACE (Multi-Agent Computing Environment) using the implementation of a distributed blackboard system as an example. MACE is an instrumented testbed for building DAI systems at different levels of granularity. MACE agents run in parallel, and communicate via messages. They have been facilities for knowledge representation (e.g., models of other agents) and reasoning. The MACE environment maps agents to processors, handles inter-agent communication, and provides a language for describing agents, tracing and instrumentation, a facility for remote demons, and a collection of system-agents which construct user-agents from descriptions, monitor execution, handle errors, and interface to a user. MACE is implemented on a 16-node INTEL SYM-1 large-memory hypercube and in a Lisp machine environment. We have used MACE to model lower-level parallelism (several distributed production rule systems) and to build higher-level distributed problem-solving architectures (distributed blackboard and contract-net schemes).

38414 **Experiments on alternatives to minimax.** Nau, D.; Purdom, P.; Tzeng, C. *International Journal of Parallel Programming;* **15**: No. 2, 163-183(Apr 1986).

In the field of Artificial Intelligence, traditional approaches to choosing moves in games involve the use of the minimax algorithm. However, recent research results indicate that minimaxing may not always be the best approach. In this paper they report some measurements on several model games with several different evaluation functions. These measurements show that there are some new algorithms that can make significantly better use of evaluation function values than the minimax algorithm does.

38415 **Monitor - The prelude to robotics.** Grisham, D.L.; Lambert, J. (Los Alamos National Lab., Los Alamos, NM 87545). pp 507-514 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Robots and teleoperator systems will play an important role in future energy systems regardless of the particular energy source. Present remote handling systems were developed for radioactive environments; however, future sources, such as fusion reactors, solar concentrators, and wind generators will also produce environments too hostile for practical "hands on" maintenance. Teleoperator systems developed at the Clinton P. Anderson Meson Physics Facility (LAMPF) are a logical prelude to performing remote operations with robots. The "Monitor" remote handling systems represent state-of-the-art mechanical hardware and operating techniques - the only elements missing are suitable computer and software interfaces.

## 9903 Information Handling

*REFER ALSO TO CITATION(S) 36802, 36812, 36813, 37380, 37565, 37641, 38404, 38406*

38416 **(AD-A—179323/1/XAB) Trace-driven simulation study of dynamic load balancing. Technical report, 7 August 1984-6 August 1987.** Zhou, S. (California Univ., Berkeley (USA). Dept. of Computer Sciences). Jan 1987. 30p. NTIS, PC A03/MF A01.

A trace-driven simulation study of dynamic load balancing in homogeneous distributed systems supporting broadcasting is presented. Information is about about job CPU and I/O demands collected from a production system as input to a simulation model that includes a representative CPU scheduling policy and considers the message exchange and job-transfer costs explicity. Seven load-balanced algorithms are simulated and their performances compared. It was found that load balancing is capable of significantly reducing the mean and standard deviation of job response times, especially under heavy system load, and for jobs with high resource demands. The performances of all hosts, even those originally with light loads, are generally improved by load balancing. The reduction of the mean response time increases with the number of hosts, but levels off at around 30 hosts. Algorithms based on periodic or non-periodic load information exchange provide similar performance, and, among the periodic policies, the algorithms that use a distinguished agent to collect and distribute load information cut down the overhead and scale better.

38417 **(AD-A—179359/5/XAB) Effects of message loss on distributed termination. Technical report.** Koo, R.; Toueg, S. (Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science). 21 Mar 1987. 18p. (CU-CSD—87-823). NTIS, PC A02/MF A01.

This document studies the problem of termination in distributed systems with faulty communication channels. It is shown that for asynchronous systems, protocols that guarantee knowledge gain via message transfers cannot be guaranteed to terminate even if we assume that only transient communication failures can occur, and want to achieve only a weak kind of termination. The same result holds for synchronous systems as well.

38418 **(BNL—39830) A guide to telecommunications at Brookhaven National Laboratory.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011291.

The first chapter of this manual is an introduction for all readers. It describes the broad range and diversity of communications services offered at Brookhaven National Laboratory. Subsequent chapters deal with specific systems and services. These chapters contain descriptive and technical information and may be read selectively. Goals of this manual are to give personnel at Brookhaven an overview of available telecommunications resources and facilities and to describe the policies and procedures involved in fulfilling communications requirements.

# CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

## A


**Acurex Corp., Mountain View, CA (USA)**
Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)

**Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.**
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)

**Acurex Corp., Research Triangle Park, NC (USA)**
Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)
Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for September 1985-April 1986, 12:37653 (R;US)
Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)
Real-time monitoring of a hazardous-waste incinerator with a mobile laboratory. Report for December 1986-January 1987, 12:37157 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)

**Adelphi Technology, Woodside, CA (USA)**
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)

**Advanced Refractory Technologies, Inc., Buffalo, NY (USA)**
Production of fine, high-purity, beta SiC powder, 12:37282 (R;US)

**AEP Service Corp., Columbus, OH (USA)**
Adaptive transmission system relaying, 12:36768 (R;US)
Impact of adaptive protection on power system control, 12:36769 (R;US)
Some applications of phasor measurements to adaptive protection, 12:37511 (R;US)

**Aerocomp, Inc., Costa Mesa, CA (USA)**
ROADWAY: a numerical model for predicting air pollutants near highways. User's guide. Final report, 12:37624 (R;US)

**Aerospace Corp., El Segundo, CA (USA). Laboratory Operations**
Generation of broadband noise in the magnetotail, 12:38081 (R;US)

**Agapito (J.F.T.) and Associates, Grand Junction, CO (USA)**
Improved stopping, door, and overcast construction for oil-shale mines. Open File report, June 1984-September 1986, 12:36465 (R;US)

**Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA)**
Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff, 12:36538 (R;US)

**Aghabian Associates, El Segundo, CA (USA)**
Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel, 12:36534 (R;US)

**AiResearch Mfg. Co., Torrance, CA (USA)**
High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report, 12:37138 (R;US)
Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)

**Air Force Engineering and Services Center, Tyndall AFB, FL (USA). Energy Group**
Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)

**Air Force Geophysics Lab., Hanscom AFB, MA (USA)**
Correlation between asymptotic directions of cosmic-ray particles and cutoff rigidities in the evolving geomagnetic field, 12:38084 (R;US)
Middle atmosphere density and models. Technical report, 12:38080 (R;US)

**Air Force Human Systems Div., Brooks AFB, TX (USA)**
Air Force Technical Objectives Document, Fiscal Year 1988. Annual report, January 1986-January 1987, 12:37185 (R;US)

**Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering**
Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis, 12:38307 (R;US)
Computer fallout code using variable winds for operational-type studies. Master's thesis, 12:37586 (R;US)
Effects of corona on heat transfer in an enclosure. Master's thesis, 12:38099 (R;US)
Frequency-shift measurements of the Q(1) and Q(2) lines of $H_2$ using high-resolution c-w Coherent Anti-Stokes Raman Spectroscopy. Master's thesis, June-October 1986, 12:38092 (R;US)
Material damping measurements of 2-d carbon-carbon composite beams. Master's thesis, 12:37324 (R;US)
Particle-size determination from local fallout. Master's thesis, 12:37587 (R;US)
Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)
Performance evaluation of parallel branch and bound search with the Intel IPSC (Intel Personal Supercomputer) hypercube computer. Master's thesis, 12:38403 (R;US)
Photoluminescence study of germanium-implanted gallium arsenide. Master's thesis, 12:37327 (R;US)
Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis, 12:38100 (R;US)
Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)

**Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)**
Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)

**Air Products and Chemicals, Inc., Allentown, PA (USA)**
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
**Alabama A and M Univ., Normal (USA)**
Statistical analysis of secondary particle distributions in relativistic nucleus-nucleus collisions, 12:38273 (R;US)
**Alabama Univ., Huntsville (USA)**
Space radiation studies. Annual report, November 1985-November 1986, 12:37567 (R;US)
**Alabama Univ., University (USA). Dept. of Chemistry**
Catalyst accessibility in high volatile bituminous coal: Quarterly report, 12:36316 (R;US)
Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987, 12:37435 (R;US)
**Alaska Dept. of Natural Resources, Fairbanks (USA). Div. of Geological and Geophysical Surveys**
Alaska geothermal bibliography, 12:36721 (R;US)
Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations, 12:36365 (R;US)
**Alaska Dept. of Natural Resources, Juneau (USA). Div. of Geological and Geophysical Surveys**
Alaska geothermal bibliography, 12:36721 (R;US)
**Alaska Univ., Fairbanks (USA). Geophysical Inst.**
Alaska geothermal bibliography, 12:36721 (R;US)
**Alliance to Save Energy, Washington, DC (USA)**
[1984 Alliance to Save Energy/DOE Cooperative Agreement], 12:37028 (R;US)
**Aluminum Co. of America, Alcoa Center, PA**
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
**American ATCON, Inc., Wilmington, DE**
Some results from the demonstration of indoor radon reduction measures in block basement houses. Report for June 1985-February 1987, 12:37720 (R;US)
**American Meteorological Society, Boston, MA**
Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version), 12:37663 (R;US)
**American Motors Corp., Detroit, MI**
Application for certification 1987 model year light-duty vehicles - American Motors Corporation (Renault), 12:37178 (R;US)
**Ames Lab., IA (USA)**
Annihilation of vortex-antivortex pairs in a superconducting shield, 12:37458 (R;US)
[Dimerization of o-quinodimethanes], 12:37399 (R;US)
Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
[Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)
Superconductivity, magnetism, and charge density wave formation in ternary compounds with the $Sc_5Co_4Si_{10}$-type structure, 12:37338 (R;US)
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**Amsterdam Univ. (Netherlands)**
Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
**Analysis and Measurement Services, Knoxville, TN (USA)**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Antrim, County of, Bellaire, MI (USA)**
Small-scale hydroelectric demonstration project: Reactivation of the Elk Rapids Hydroelectric Facility: Final operation and maintenance report, 12:36615 (R;US)
**AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki**
Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
**Applied Physics, Inc., Albuquerque, NM (USA)**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
**Arctec, Inc., Columbia, MD (USA)**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**Argonne National Lab., IL (USA)**
Acoustic leak detection for district heating systems: Results of Phase 1: Laboratory assessment, 12:37153 (R;US)
AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process, 12:37286 (R;US)
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
An improved method for the simultaneous determination of $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$ in water, soils and sediments, 12:37848 (R;US)
Arms control and treaty verification technology: Contributions from the nonweapons laboratories, 12:37194 (R;US)
Assessment of radioisotope heaters for remote terrestrial applications, 12:36574 (R;US)
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin, 12:36294 (R;US)
Considerations pertinent to the Doppler effect for space reactors, 12:36785 (R;US)
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials, 12:37287 (R;US)
Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)
Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range, 12:38233 (R;US)
Dynamic behavior of reacting gas jets submerged in liquids, 12:37390 (R;US)
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
Effect of flaws on the fracture behavior of structural ceramics, 12:37292 (R;US)
Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)
Evidence for the decay tau$^- \rightarrow \pi^-$ eta nu/sub tau/, 12:38111 (R;US)
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project, 12:36782 (R;US)
Gas pressure and concentration gradients at the top of a landfill, 12:37824 (R;US)
High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells, 12:37009 (R;US)
Institutional Conservation Program evaluation project: Results of higher education survey pretest, 12:37016 (R;US)
Institutional Conservation Program Evaluation Project: Results of hospital survey pretest, 12:37017 (R;US)
Magneto-optical studies of ultra-thin epitaxial films of fcc Fe on Cu(100), 12:37216 (R;US)
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
Materials for FBC [fluidized-bed combustion] air heater applications, 12:36351 (R;US)
4,5-methylenedithio-4',5'-propylenedithiotetrathiafulvalene (MPT) and 4,5-ethylenedithio-4',5'-propylenedithiotetrathiafulvalene (EPT), 12:37389 (R;US)
Microconvection effects at gradient zone boundaries, 12:36701 (R;US)
Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)
Minority participation in new energy technologies: A case example of electric heat pumps, 12:37024 (R;US)
Modeling americium separations in stagewise solvent extraction, 12:37437 (R;US)
Molten salt battery advances, 12:36941 (R;US)
Monolithic fuel cells, 12:37010 (R;US)

Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals, 12:38296 (R;US)
NDE [nondestructive evaluation] and fracture studies of hot-pressed $Si_3N_4$, 12:37285 (R;US)
Nuclear waste package fabricated from concrete, 12:36503 (R;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
Particle evolution in MHD systems, 12:37005 (R;US)
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules, 12:36622 (R;US)
Power performance of high-temperature Li-alloy/$FeS_2$ bipolar cells in short pulses, 12:36942 (R;US)
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
Present and future prospects of accelerator mass spectrometry, 12:37370 (R;US)
Production and characterization of pyrolysis liquids from municipal solid waste, 12:37855 (R;US)
Projecting market demand for residential heat pumps, 12:37018 (R;US)
Pyrolysis of municipal solid waste, 12:37154 (R;US)
Recent results on polarizations and the present status of the Fermilab polarized beams, 12:38110 (R;US)
Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions, 12:36824 (R;US)
Semi-inclusive inelastic electron scattering from nuclei, 12:38265 (R;US)
Solution to workshop problem 6 (hollow sphere) in the shell approximation with EDDYNET-2D, 12:38322 (R;US)
Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory, 12:37387 (R;US)
The death spiral: An assessment of its likelihood in electric utilities, 12:36993 (R;US)
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
The Fermi surface of CeSb, 12:37205 (R;US)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O/sub\ x/$, 12:37288 (R;US)
Transportation energy outlook under conditions of persistently low petroleum prices, 12:36416 (R;US)
Tritons and tritides as the solute and diffusing species in ceramic tritium breeders, 12:38370 (R;US)
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
Unorthodox lattice fermion derivatives and their shortcomings, 12:38214 (R;US)
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
Validation of an intermediate heat exchanger model for real time analysis, 12:36818 (R;US)
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)

**Arinc Research Corp., Annapolis, MD (USA)**
Availability analysis of an integrated gasification-combined cycle: Final report, 12:36751 (R;US)

**Arizona State Univ., Tempe (USA)**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)

**Arizona Univ., Tucson (USA). Dept. of Chemistry**
Chelating extractants of improved selectivity: Final report, 12:37373 (R;US)

**Army Armament Research and Development Command, Watervliet, NY (USA). Benet Weapons Lab.**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)

**Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies**
Command and control of the US heavy division on the nuclear battlefield, 12:37588 (R;US)
Tactical encirclement reductions, 12:37589 (R;US)

**Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)**
Laser Hazards Bibliography (12th Edition), 12:38011 (R;US)

**Atkins (W.S.) and Partners, Epsom (UK)**
First report on the visual impact of large wind turbines, 12:36737 (R;GB)

**Atomic Energy of Canada Ltd., Chalk River, Ontario**
FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements, 12:37244 (R;US)

**Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.**
High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells, 12:37009 (R;US)

**Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations**
Lessons learned from hydrogen generation and burning during the TMI-2 event, 12:36829 (R;US)

**Auburn Univ., AL (USA). Coal Conversion Lab.**
Configurational diffusion of coal macromolecules: Quarterly progress report, March 15, 1987 to June 15, 1987, 12:36317 (R;US)

**Automatix, Inc., Billerica, MA (USA)**
Computer-aided radiograph analysis, 12:37507 (R;US)

## B

**Battelle Columbus Div., OH (USA)**
Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986, 12:36804 (R;US)
Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)

**Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation**
Comparison of results for ten analytical heat conduction problems as solved by the general heat transfer code HEATING5 [Heat Engineering and Transfer in Nine Geometries], 12:36498 (R;US)
Determination of background radiological characteristics within the Palo Duro Basin, Texas: Technical report, 12:37818 (R;US)
Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36496 (R;US)
Regional ground-water flow near Richton and Cypress Creek Domes, Mississippi: Annual status report for fiscal year 1984, 12:37854 (R;US)
Verification report for SIMREP 1.1, 12:36499 (R;US)

**Battelle Memorial Inst., Richland, WA (USA)**
STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)

**Battelle Pacific Northwest Lab., Richland, WA (USA)**
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)

**BDM Corp., McLean, VA (USA)**
Slow speed coal/water slurry fired diesels in industrial cogeneration: Market evaluation, 12:37135 (R;US)

**Bechtel National, Inc., San Francisco, CA (USA)**
Design of agitation systems in Bingham slurries by pilot simulation, 12:36511 (R;US)
Design of saltstone vaults, 12:36512 (R;US)

**Bechtel Power Corp., San Francisco, CA (USA)**
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)

**Bell Labs., Murray Hill, NJ (USA)**
Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O/sub\ x/$, 12:37288 (R;US)

**Bend Research, Inc., OR (USA)**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)

**Bhabha Atomic Research Centre, Bombay (India). Technical Physics and Prototype Engineering Div.**
A circuit for characterization of ferroelectrics, 12:37510 (R;IN)

**Binnie and Partners, London (UK)**
Preliminary survey of tidal energy of U.K. estuaries, 12:36732 (R;GB)

**BioSystems Analysis, Inc., Santa Cruz, CA (USA)**
Vegetation of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California, 12:37828 (R;US)
**Bipel International, Inc., Trumbull, CT (USA)**
Thermoelectric conversion with ion conductors. Quarterly technical progress report No. 2, 1 November 1986-15 January 1987, 12:37007 (R;US)
**Birch og Krogboe Raadgivende Ingenioerkontor, Virum (Denmark)**
Proposal of a floating tide power plant in Vestmannasund, 12:36734 (R;DK;In Danish)
**Bochum Univ. (Germany, F.R.). Abt. fuer Chemie**
Trace element analyses in order to determine heavy metal concentrations in lung tissues. A contribution to an objective assessment of occupational hazards, 12:37985 (R;DE;In German)
**Bochum Univ. (Germany, F.R.). Inst. fuer Experimentalphysik**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
**Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 162 - Plasmaphysik Bochum/Juelich**
Kinetics of excitation and ionization of Be I in tokamak devices, 12:38354 (R;DE)
**Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet**
Methane production from lactose via defined mixed cultures of bacteria, 12:36631 (R;DE;In German)
**Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)**
Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
**Boston Univ., MA (USA)**
Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)
**Boston Univ., MA (USA). Dept. of Chemistry**
Investigation of the triplet state of chlorophylls: Final report, May 1, 1975 through April 30, 1987, 12:36624 (R;US)
**Bricmont and Associates, Inc., McMurray, PA (USA)**
Development of an advanced gas-fired furnace for high-temperature heating of continuously cast thin-section steel products. Final report, January-December 1986, 12:36463 (R;US)
**Brigham Young Univ., Provo, UT (USA)**
Identification of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate in the Los Angeles atmosphere, 12:37645 (R;US)
Thermodynamics of molecular interactions in coal liquids: Progress report for the period July-December 1986, 12:36260 (R;US)
**Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy**
Enhancing the muon-catalyzed fusion yield, 12:38324 (R;US)
**British Coal, Stanhope Brethy. HQ Technical Dept.**
Development of free-steered vehicles, 12:36339 (R;GB)
**Brookhaven National Lab., Upton, NY (USA)**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)
A safeguards risk approach to inspection scheduling, 12:36557 (R;US)
Accelerated Leach Test(s) Program: Annual report, 12:36500 (R;US)
An assessment of the graphics upgrade needs of technology policy: Office of Policy, Planning and Analysis, 12:38407 (R;US)
An environmental source book on the photovoltaics industry, 12:36958 (R;US)
An introduction to the physics and instrumentation of positron emission tomography, 12:37874 (R;US)
Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
Artificial magnetic superlattices, 12:38295 (R;US)
Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
Electroweak radiative corrections and neutral current phenomenology, 12:38112 (R;US)
Emergency response training with the BNL plant analyzer, 12:36811 (R;US)
Low-level waste source term evaluation: Review of published modeling and experimental work, and presentation of low-level waste source term modeling framework and preliminary model development: Topical report, 12:36521 (R;US)
Magnetism of MnSi and FeSi, 12:37328 (R;US)
Monte Carlo algorithms for lattice gauge theory, 12:38215 (R;US)
Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)
Particle Bed Reactor scaling relationships, 12:36784 (R;US)
Plant lifetime reliability and risk: Addressing today's strategies for making tomorrow's decisions, 12:36823 (R;US)
Radon source rate measurements using multiple perfluorocarbon tracers, 12:37709 (R;US)
Review of the Brookhaven neutrino workshop, 12:38113 (R;US)
Shelf Edge Exchange Processes: Phase 1 (SEEP-1), Hydrography report, July 1983-October 1984, 12:38049 (R;US)
Some thoughts on the muon catalyzed fusion reactor, 12:38320 (R;US)
Studies of hypernuclei by associated production, 12:38237 (R;US)
$\nu$/sub $\mu$/e $\rightarrow$ $\nu$/sub $\mu$/e and $\nu$/sub $\mu$/p $\rightarrow$ $\nu$/sub $\mu$/p, 12:38114 (R;US)
Tests of candidate materials for particle bed reactors, 12:36780 (R;US)
The application of a synchrotron radiation microprobe to trace element analysis, 12:37873 (R;US)
The role of dry deposition in acidification of waters, 12:37767 (R;US)
Thermal-hydraulic considerations for particle bed reactors, 12:36781 (R;US)
Tranverse beam break up in a periodic linac, 12:37540 (R;US)
Two-zone modelling for air exchange rates and $NO_2$ source and decay rates in a Southern California residential indoor air quality study, 12:37600 (R;US)
**Brown Univ., Providence, RI (USA). Dept. of Physics**
A research program in experimental high energy physics: Task B, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38120 (R;US)
A research program in experimental high energy physics: Task C, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38118 (R;US)
A research program in theoretical high-energy physics: Progress report, 12:38158 (R;US)
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
Inclusive charged and neutral pion photoproduction at 20 GeV, 12:38119 (R;US)
Research program in computational physics: [Progress report for Task D], 12:38159 (R;US)
**Brown Univ., Providence, RI (USA). Div. of Engineering**
Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 December 1986-15 March 1987, 12:36271 (R;US)
**Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)**
Radioactivity in foods - Chernobyl and the consequences, 12:37817 (R;DE;In German)
**Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene**
Carbon and carbon metabolism in the environment, 12:37905 (R;DE)
Comparative investigations of different measurement methods of Radiochromatograms for the evaluation of the radiochemical purity of ten radiopharmaceuticals, 12:37438 (R;DE;In German)
Influence of radiation treatment on pharmaceuticals and auxiliary ingredients. A review. Pt. 7, 12:37440 (R;DE;In German)
Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis, 12:37439 (R;DE;In German)
Results of the activity measurements after the reactor accident in Chernobyl, 12:37710 (R;DE;In German)
Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 1, 12:37898 (R;DE;In German)
Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 2, 12:37899 (R;DE;In German)

**Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)**
Biomass production of problematic sites by generatively and vegetatively propagated high-yield-progenies of fast growing tree species. Final report, 12:36621 (R;DE;In German)
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)
Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report, 12:36580 (R;DE;In German)
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor, 12:36822 (R;DE;In German)
**Bureau of Mines, Avondale, MD (USA). Avondale Research Center**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Bureau of Mines, Denver, CO (USA). Denver Research Center**
Thick-seam mining in the Western United States--geological considerations. Information Circular/1986, 12:36343 (R;US)
**Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center**
Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986, 12:36342 (R;US)
Wood crib fires in a ventilated tunnel. Report of Investigations/1986, 12:36366 (R;US)
**Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Research Center**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center**
Study of saline water use at the Harry Allen Generating Station. Final report, 12:36756 (R;US)

## C

**California Dept. of Health Services, Berkeley (USA). Air and Industrial Hygiene Lab.**
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
**California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.**
Control of atmospheric fine primary carbon particle concentrations. Final report, 12:37654 (R;US)
**California Univ., Berkeley (USA). Coll. of Engineering**
Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)
**California Univ., Berkeley (USA). Dept. of Chemical Engineering**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)
**California Univ., Berkeley (USA). Dept. of Chemistry**
Picosecond studies of multiphoton absorption: Final technical report, 12:37395 (R;US)
**California Univ., Berkeley (USA). Dept. of Computer Sciences**
Trace-driven simulation study of dynamic load balancing. Technical report, 7 August 1984-6 August 1987, 12:38416 (R;US)
**California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering**
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
Generation and analysis of stable excavation shapes under high rock stresses, 12:38044 (R;US)
**California Univ., Berkeley (USA). Electronics Research Lab.**
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)
**California Univ., Los Angeles (USA)**
AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process, 12:37286 (R;US)
**California Univ., Los Angeles (USA). Dept. of Chemistry and Biochemistry**
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**California Univ., Los Angeles (USA). Tokamak Fusion Lab.**
Ray tracing analysis of LH [lower hybrid] fast waves in CCT [Continuous Current Tokamak], 12:38355 (R;US)
**California Univ., San Diego (USA)**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**California Univ., Santa Barbara (USA). Dept. of Electrical and Computer Engineering**
The structure of GaAs/Si(211) heteroepitaxial layers, 12:37340 (R;US)
**Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Mechanical and Aerospace Engineering**
Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period March 1, 1987 to May 31, 1987, 12:37493 (R;US)
**Caterpillar Tractor Co., Peoria, IL (USA)**
Application for certification 1987 model year heavy-duty engines - Caterpillar, 12:37169 (R;US)
**CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Basses Temperatures**
The Fermi surface of CeSb, 12:37205 (R;US)
**CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)**
Vignola project, 12:36654 (R;FR;In French)
**Center for Neighborhood Technology, Chicago, IL (USA)**
Energy conservation business opportunities in multifamily housing: Executive summary and conclusions: [Final report], 12:37061 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper: [Final report], 12:37063 (R;US)
Energy conservation business opportunities in multifamily housing: Feasibility analysis/business plan for proposed residential balancing venture: [Final report], 12:37062 (R;US)
**Central Intelligence Agency, Washington, DC (USA)**
International Energy Statistical Review. Monthly report, 12:36986 (R;US)
**Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)**
Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**Centre National de la Recherche Scientifique, 38 - Grenoble (France). Centre de Recherches sur les Tres Basses Temperatures**
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)
**Centro de Pesquisas de Energia Eletrica, Rio de Janeiro (Brazil)**
Composite generation-transmission expansion planning: Final report, 12:36770 (R;US)

**CeramPhysics, Inc., Westerville, OH (USA)**
Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986, 12:36937 (R;US)
**Chicago Univ., IL (USA)**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
Theoretical high energy physics research at the University of Chicago: Technical progress report [for 1986], 12:38160 (R;US)
**Chicago Univ., IL (USA). Dept. of Geophysical Sciences**
The application of a synchrotron radiation microprobe to trace element analysis, 12:37873 (R;US)
**Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)**
Economic analysis of natural gas contracts, 12:36435 (R;NO)
Optimal investments using empirical dynamic programming with application to natural resources, 12:36436 (R;NO)
Petroleum taxes and optimal resource recovery, 12:36414 (R;NO)
Progress curves for North Sea platform projects, 12:36415 (R;NO)
Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)
Safety and optimal prevention of platform accidents, 12:36413 (R;NO)
**Chrysler Corp., Detroit, MI (USA)**
Application for certification 1987 model year heavy-duty engines - Chrysler, 12:37170 (R;US)
Application for certification 1987 model year light-duty vehicles - Chrysler, 12:37173 (R;US)
**City Coll., New York (USA)**
Experimental investigations of production of glueballs and meson resonant states, 12:38123 (R;US)
**City Univ. of New York, NY (USA). Research Foundation**
Experimental investigations of production of glueballs and meson resonant states, 12:38123 (R;US)
**Cliffs Engineering, Inc., Rifle, CO (USA)**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)
**Coast Guard Research and Development Center, Groton, CT (USA)**
United States Coast Guard portable salvage computer. Final report, 12:36956 (R;US)
**College of William and Mary, Williamsburg, VA (USA). Dept. of Physics**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Colorado School of Mines, Golden (USA)**
Shock-modified transition metal ferrites, 12:37348 (R;US)
**Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining**
Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987, 12:36272 (R;US)
**Colorado School of Mines, Golden (USA). Inst. for Energy Resource Studies**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Colorado Univ., Boulder (USA)**
Master-equation approach to collisionally induced absorption and emission, 12:38093 (R;US)
**Colorado Univ., Boulder (USA). Dept. of Astrophysical, Planetary, and Atmospheric Sciences**
Vector-array-processor computer equipment. Final report, 1 January-31 December 1985, 12:38052 (R;US)
**Columbia Univ., New York (USA). Columbia Astrophysics Lab.**
Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986, 12:38050 (R;US)
**Columbia Univ., New York (USA). Dept. of Physics**
Theoretical high energy physics: Progress report for the period May 1, 1986-April 30, 1987, 12:38157 (R;US)
**Combustion Engineering Association, London (UK)**
Low temperature heat recovery, 12:37104 (R;GB)
**Combustion Engineering, Inc., Windsor, CT (USA)**
Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987, 12:36361 (R;US)
**Commission of the European Communities, Luxembourg**
Alfa Romeo modular taxi: Demonstration project. Final report, 12:37162 (R;FR)
Basic characteristics for low-cost houses in order to reduce the energy consumption for heating, 12:37068 (R;FR)
Continuous production of photovoltaic silicon ribbons by the new pendant drop growth (PDG) method, 12:36629 (R;XE)
Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)
Passenger-car emissions in the speed range 80-120 kmph. Traffic measurements on a fleet of cars in the Pfaender Road Tunnel, 12:37183 (R;XE;In German)
Quality and quantity of latex which can be produced from natural vegetation in Greece, 12:36630 (R;FR)
Short-rotation harvester/chipper, 12:36633 (R;XE)
Solar energy: European research and development. Contractors' catalogue 1984, 12:36619 (R;XE)
**Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation**
Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)
Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)
Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**Community Action Commission of Fayette County, Washington Court House, OH (USA)**
Code name: Opportunity battery: Phases 1 and 2 of Department of Energy Business Plan, 12:38392 (R;US)
**COMSIS Corp., Wheaton, MD (USA)**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
Baltimore feeder-bus planning study. Final report, 12:37100 (R;US)
**Concawe, The Hague (Netherlands)**
Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)
Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
**Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)**
35 years of electron scattering, 12:38271 (R;US)
An optimized input waveguide for the CEBAF [Continuous Electron Beam Accelerator Facility] Superconducting Linac Cavity, 12:37549 (R;US)
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
Electromagnetic studies in nuclei, 12:38234 (R;US)
Multipass beam breakup in the CEBAF [Continuous Electron Beam Accelerator Facility] superconducting linac, 12:37541 (R;US)
Optics of beam recirculation in the CEBAF [Continuous Electron Beam Accelerator Facility] cw linac, 12:37542 (R;US)
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
Short range phenomena, 12:38161 (R;US)
Spin degrees of freedom in electron nucleon scattering in the resonance region, 12:38124 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] project, 12:37529 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] control system architecture, 12:37531 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] cavity cryostat, 12:37548 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] superconducting accelerator: An overview, 12:37530 (R;US)
The Continuous Electron Beam Accelerator Facility, 12:37532 (R;US)
**Continuum, Inc., Huntsville, AL (USA)**
Computational analyses of crystal growth. Final report, 12:37345 (R;US)
**Coordinating Research Council, Inc., Atlanta, GA (USA)**
Field evaluation of the sidestream sensors for filter/separators and clay filters, 12:36411 (R;US)
**Cornell Univ., Ithaca, NY (USA)**
Adaptive transmission system relaying, 12:36768 (R;US)

An optimized input waveguide for the CEBAF [Continuous Electron Beam Accelerator Facility] Superconducting Linac Cavity, 12:37549 (R;US)
Evaluation of local strain fields at [001] twist boundaries in silicon with transmission electron microscope diffraction: Final subcontract report, 12:36635 (R;US)
Impact of adaptive protection on power system control, 12:36769 (R;US)
Some applications of phasor measurements to adaptive protection, 12:37511 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] cavity cryostat, 12:37548 (R;US)

**Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science**
Effects of message loss on distributed termination. Technical report, 12:38417 (R;US)

**Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering**
The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)

**Costello (Kenneth W.), Springfield, IL (USA)**
The death spiral: An assessment of its likelihood in electric utilities, 12:36993 (R;US)

**Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Transport and Road Research**
Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report, 12:37102 (R;ZA)

**Crucible Research Center, Pittsburgh, PA (USA)**
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**Crystal Systems, Inc., Salem, MA (USA)**
Growth of garnet crystals for laser applications. Final report, 1 February-31 July 1984, 12:37485 (R;US)

## D

**Dalhousie Univ., Halifax, Nova Scotia (Canada)**
Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)

**Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3**
Efficient refrigerators with small compressors, 12:37075 (R;DK;In Danish)

**Danmarks Tekniske Hoejskole, Lyngby. Inst. for Mineralindustri**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)

**Danmarks Tekniske Hoejskole, Lyngby. Kemisk Lab. A**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)

**Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering**
Development of an efficient and inexpensive concentrating solar collector, 12:36702 (R;DK;In Danish)

**Dansk Kedelforening Energi and Miljoe, Soborg**
Switching-off power loads in industry, 12:36998 (R;DK;In Danish)

**Dearborn Environmental Consulting Services (Canada)**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)

**Delaware Univ., Newark (USA). Center for Catalytic Science and Technology**
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)

**Department of Energy, Washington, DC (USA)**
Waste disposal package, 12:36542 (P;GB)

**Department of National Education, Pretoria (South Africa)**
National Register of research projects: Part 1, Natural sciences: Biological, medical and related sciences, 12:38397 (R;ZA;In Afrikaans and English)

**Department of the Treasury, Washington, DC (USA). Office of Tax Analysis**
Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats, 12:36955 (R;US)

**Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)**
Instrument for the quasi-continuous determination of the atmospheric soot content, 12:37525 (R;DE;In German)

**Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere**
Instrument for the quasi-continuous determination of the atmospheric soot content, 12:37525 (R;DE;In German)

**Deutsche Gesellschaft fuer Chemisches Apparatewesen, Chemische Technik und Biotechnologie e.V. (DECHEMA), Frankfurt am Main (Germany, F.R.)**
Environmental problems involved in the disposal of fly ash from waste incineration on waste dumps. Summaries, 12:37807 (R;DE;In German)

**Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)**
Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
Excited lepton search, 12:38116 (R;DE)
NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
Strong CP problem and the visibility of invisible axions, 12:38156 (R;DE)

**Dijon Univ., 21 (France)**
Development possibilities of solid mineral fuels in the energy balance of Morocco, 12:36978 (R;FR;In French)

**Dortmund Univ. (Germany, F.R.). Abt. Chemietechnik**
Optimisation of a membrane cell cascade for chlorine alkali electrolysis under the aspect of energy consumption, 12:37405 (R;DE;In German)
Safety characteristics of polynary fuel/air mixtures and self-disintegrating substances, 12:37443 (R;DE;In German)

**Dortmund Univ. (Germany, F.R.). Abt. Maschinenbau**
High-temperature solar kilns for brickmaking - a contribution towards thermodynamic design of a system for the utilization of solar process heat, 12:36686 (R;DE;In German)

**Drexel Univ., Philadelphia, PA (USA). Dept. of Civil Engineering**
Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report, 12:36588 (R;US)

**Duesseldorf Univ. (Germany, F.R.). Physikalisches Inst. - Lehrstuhl 2**
Kinetics of excitation and ionization of Be I in tokamak devices, 12:38354 (R;DE)

**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant**
A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)
Protective clothing use at the Savannah River Plant Nuclear Facility, 12:37457 (R;US)

**Dynamac Corp., Rockville, MD (USA). Enviro Control Div.**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)

## E

**Earth Technology Corp., Long Beach, CA (USA)**
Regional ground-water flow near Richton and Cypress Creek Domes, Mississippi: Annual status report for fiscal year 1984, 12:37854 (R;US)

**Eaton Operating Co., Inc., Houston, TX (USA)**
Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)

**Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
Development possibilities of solid mineral fuels in the energy balance of Morocco, 12:36978 (R;FR;In French)
Selective absorption of hydrogen sulfide in carbon dioxide by methyldiethanolamine. Study of a new type of vertical ascending cocurrent flow contactor, 12:37375 (R;FR;In French)
**Economic Research Service, Washington, DC (USA). Agriculture and Rural Economics Div.**
Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)
**EG and G Idaho, Inc., Idaho Falls (USA)**
Applicability of fracture mechanics to lifetime prediction of B and W ceramic heat exchanger tubes, 12:37137 (R;US)
Fusion Safety Program annual report: Fiscal year 1986, 12:38378 (R;US)
Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)
Severe Accident Sequence Analysis Program: Anticipated transient without scram simulations for Browns Ferry Nuclear Plant Unit 1, 12:36919 (R;US)
The future of nuclear power, 12:36975 (R;US)
Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
**EG and G/Washington Analytical Services Center, Inc., Albuquerque, NM (USA)**
The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
**Eidgenoessische Anstalt fuer das Forstliche Versuchswesen, Birmensdorf**
Inventorying and monitoring endangered forests, 12:37768 (R;DE;In English, French and German)
**Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik**
The Fermi surface of CeSb, 12:37205 (R;US)
**Electric Power Research Inst., Palo Alto, CA (USA)**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)
Availability analysis of an integrated gasification-combined cycle: Final report, 12:36751 (R;US)
Chemical form and leachability of inorganic trace elements in coal ash: Final report, 12:36328 (R;US)
Competition: Pressures for change: Final report, 12:36996 (R;US)
Composite generation-transmission expansion planning: Final report, 12:36770 (R;US)
Electrical behavior of wind power stations: Final report, 12:36646 (R;US)
Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report, 12:37609 (R;US)
Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report, 12:37610 (R;US)
IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0, 12:36814 (R;US)
Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report, 12:36754 (R;US)
Improvement in accuracy of prediction of electrical machine constants and generator models for subsynchronous resonance conditions: Volume 3, Development and benefit assessment of finite-element-based saturation model: Final report, 12:36753 (R;US)
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)
Ninth EPRI Member Utility Survey results, 12:36997 (R;US)
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)
Proceedings: 1986 Electric Utility Market Research symposium, 12:36995 (R;US)
Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
Recommended practices for operating and maintaining steam surface condensers: Final report, 12:36752 (R;US)
Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report, 12:36610 (R;US)
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**Electric Research and Management, Export, PA (USA)**
Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)
**Electric Research and Management, St. Rose, LA (USA)**
Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)
**Electrink, Inc., San Diego, CA (USA)**
Synthesis of organometallic compounds: Final technical report, 12:37336 (R;US)
**Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)**
Model with two reservoirs used in a multisystem model, 12:36609 (R;NO;In Norwegian)
**Eltron Research, Inc., Aurora, IL (USA)**
Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986, 12:36578 (R;US)
**ENEA, Rome (Italy)**
Analytical treatment of Free Electron Laser in the long pulse limit, 12:37477 (R;IT)
Approach to a more rational use of energy in the textile area of Prato. Diffusion proposals and operative indications of intervention, 12:37141 (R;IT;In Italian)
Calculations of total fusion power and spatial distribution of emissivity for a D-T thermal plasma. Part I, 12:38335 (R;IT)
Contributions to the 14th symposium on fusion technology, 12:38379 (R;IT)
Delphos project - Wind actions on a parallel-rope tensio-structure for photovoltaic systems, 12:36645 (R;IT;In Italian)
Environmental effects due to the use of conventional and innovating fuels for autotraction, 12:37607 (R;IT;In Italian)
Environmental indicators: a comparison of international trends, 12:37857 (R;IT;In Italian)
Ethanol production from agricultural raw materials, 12:36992 (R;IT;In Italian)
Feasibility study about a National Integrated Informative System in the energy field. Results of a research on the national real demand of energetic information, 12:36980 (R;IT;In Italian)
Increase of current from 35 to 120 mA of the 20 MeV Frascati microtron, 12:37482 (R;IT)
Instability in a multimode Free Electron Laser: effects of electron energy drift, 12:37476 (R;IT)
Materials depositions produced by laser radiation, 12:37481 (R;IT;In Italian)
Research and development activities on the Free Electron Laser (FEL) at the ENEA Frascati Energy Researches Center, 12:37475 (R;IT;In Italian)
Self-consistent classical analysis of a start-up in a Free Electron Laser, 12:37478 (R;IT)
Spontaneous emission in a double dielectric slab for Cerenkov-FEL operation, 12:37480 (R;IT)
Spontaneous emission in Cerenkov FEL devices: a preliminary theoretical and experimental analysis, 12:37479 (R;IT)
The cost of kWh generated from nuclear stations, 12:36798 (R;IT;In Italian)
**Energy and Environmental Research Corp., Irvine, CA (USA)**
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
**Energy Research Corp., Danbury, CT (USA)**
Aircraft battery state of charge and charge-control system. Interim report, 1 July 1985-30 June 1986, 12:36940 (R;US)
**Energy Systems Associates, Tustin, CA (USA)**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)

**Energy Transition Corp., Santa Fe, NM (USA)**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Engineering-Science, Inc., Fairfax, VA (USA)**
Handbook for the review of excess emission reports. Final report, 12:37681 (R;US)
**Entropy Environmentalists, Inc., Research Triangle Park, NC (USA)**
Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)
**Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.**
Water-quality-modeling software available from US EPA (Environmental Protection Agency), 12:37839 (R;US)
**Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment**
Summary review of the health effects associated with copper: health issue assessment, 12:37990 (R;US)
**Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.**
Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)
**Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.**
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
Comparison of electrostatic-precipitator performance with pulse and d-c energization, 12:37668 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985, 12:37652 (R;US)
Resolving the radon problem in Clinton, New Jersey houses. Published paper, April-December 1986, 12:37718 (R;US)
Statistical aspects of autoregressive models in the assessment of radon mitigation, 12:37717 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.**
Air-pollution models as descriptors of cause-effect relationships, 12:37638 (R;US)
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
Episodic coincident air-quality and precipitation measurements in an urban setting, 12:37664 (R;US)
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
Nitric acid-air diffusion coefficient: experimental determination, 12:37639 (R;US)
Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)
Sources and evaluation of uncertainty in long-range transport models, 12:37691 (R;US)
Transition-flow reactor tube for measuring trace-gas concentrations, 12:37646 (R;US)
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office**
Air-Quality Criteria for Particulate Matter and Sulfur Oxides (1982) (second addendum): assessmet of newly available health-effects information. Final report, 12:37642 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.**
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.**
Airway sensitivity of asthmatics to sulfur dioxide, 12:37994 (R;US)
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
Interspecies dosimetry of reactive gases, 12:37996 (R;US)
Modeling ozone absorption in the lower respiratory tract, 12:38001 (R;US)
Pulmonary antioxidants, 12:38004 (R;US)
Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards**
National air quality and emissions trends report, 1985, 12:37657 (R;US)
National air-pollutant-emission estimates, 1940-1985. Final report, 12:37666 (R;US)
Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
Review of national emission standards for mercury (final environmental impact statement), 12:37650 (R;US)
VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)
Zinc/zinc oxide preliminary source assessment, 12:37690 (R;US)
**Environmental Protection Agency, Research Triangle Park, NC (USA). Strategies and Air Standards Div.**
Review of the national ambient air-quality standards for particulate matter: updated assessment of scientific and technical information. Addendum to the 1982 OAQPS (Office of Air Quality Planning and Standards) staff paper. Final report, 12:37727 (R;US)
**Environmental Protection Agency, Washington, DC (USA)**
Application for certification 1987 model year heavy-duty engines, 12:37168 (R;US)
Application for certification 1987 model year light-duty vehicles, 12:37172 (R;US)
Application for certification 1987 model year light-duty vehicles, 12:37181 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.**
Bibliography on asbestos in schools, 12:37687 (R;US)
Bibliography on chemical emergency preparedness and prevention, 12:36967 (R;US)
Bibliography on indoor radon pollution, 12:37721 (R;US)
Risk assessment, management, communication: a guide to selected sources. Information guide, 12:36966 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Administration**
EPA (Environmental Protection Agency) Publications Bibliography. Quarterly abstract bulletin. Quarterly report, 12:36968 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response**
Superfund public health evaluation manual, 12:37892 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment**
Evaluation of the carcinogenicity of unleaded gasoline, 12:38002 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Pesticide Programs**
Cadmium technical support document, 12:37995 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Pesticides and Toxic Substances**
Preliminary evaluations of initial TSCA (Toxic Substances Control Act) Section 8(e) substantial risk notices. January 1, 1985 to December 31, 1986, 12:37891 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Research and Development**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)

**Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste**
Minimum-technology guidance on single-liner systems for landfills, surface impoundments, and waste piles - design, construction, and operation. Draft report 1982-85, 12:37809 (R;US)
**Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste and Emergency Response**
Superfund innovative technology evaluation (site) strategy and program plan, 12:37811 (R;US)
**Environmental Research and Technology, Inc., Newbury Park, CA (USA)**
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 1. Adaptation of the mechanism. Final report, March 1986-February 1987, 12:37660 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 2. Guidelines for using the mechanism. Final report, March 1986-February 1987, 12:37661 (R;US)
**ERA Technology Ltd., Leatherhead (UK)**
Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis, 12:36739 (R;GB)
**European Space Agency, 75 - Paris (France)**
Theoretical study of the nonsteady combustion of composite fuel droplets, 12:37446 (TG;FR)
**Exeter Associates, Bethesda, MD (USA)**
Documentation and user's manual for the Utility Cost Analysis Model. Final report, 12:36953 (R;US)

## F

**Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy**
Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)
**Fenix and Scisson, Inc., Las Vegas, NV (USA)**
Initial testing and resulting redesign of the 96-inch diameter Robbins Disc Cutter Bit at the Nevada Test Site, 12:37455 (R;US)
**Fermi National Accelerator Lab., Batavia, IL (USA)**
A multiple node software development environment, 12:38410 (R;US)
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
Cosmic strings in an expanding spacetime, 12:38058 (R;US)
Experimental results on heavy flavour hadro- and photo-production, 12:38126 (R;US)
List processing software for the LeCroy 1821 Segment Manager Interface, 12:38409 (R;US)
Simulation of space charge effects and transition crossing in the Fermilab Booster, 12:37543 (R;US)
Study of charm production mechanisms at the Fermilab Tagged Photon Spectrometer: $\gamma$Be yields D anti D x and $\gamma$A yields psi x, 12:38125 (R;US)
VMS software for the Jorway-411 interface, 12:38408 (R;US)
**Fish and Wildlife Service, Washington, DC (USA)**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**Florida Audubon Society, Maitland (USA)**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
**Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics**
[DNA repair and the regulation of replication]: Progress report for 1983-1986, 12:37863 (R;US)
**Florida Univ., Gainesville (USA)**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
**Florida Univ., Gainesville (USA). Center for Wetlands**
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**Florida Univ., Gainesville (USA). Dept. of Physics**
Curvature of Super Diff($S^1$)/$S^1$, 12:38216 (R;US)
On the evolution of global strings in the early universe, 12:38057 (R;US)
The superstring, Diff$S^1$/$S^1$, and holomorphic geometry, 12:38217 (R;US)
X-ray scattering studies of non-equilibrium ordering processes: Progress report, August 1, 1986-October 31, 1987, 12:37217 (R;US)
**Food and Drug Administration, Washington, DC (USA). Center for Food Safety and Applied Nutrition**
Environmental Assessment Technical Assistance Handbook, 12:36964 (R;US)
**Ford Motor Co., Dearborn, MI (USA)**
Application for certification 1987 model year light-duty vehicles and light-duty trucks - Ford Motor Company, 12:37174 (R;US)
**Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station**
Reclamation of borrow pits and denuded lands: Final report, September 1, 1976 to December 31, 1985, 12:37765 (R;US)
**Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung**
Agricultural utilization of thermal waters - demonstration program. Pt. 2. Detailed scheme of the demonstration program 'Agricultural utilization of geothermal waters in Waltersdorf' and establishment of an individual investigation program. Final report, 12:37144 (R;DE;In German)

## G

**Gas Research Inst., Chicago, IL (USA)**
Topical report on the meeting of the Gas Research Institute Indoor Air-Quality Research Advisory Committee. Final report, February 11-13, 1986, 12:37682 (R;US)
**GA Technologies, Inc., San Diego, CA (USA)**
Enhanced particle flux control in a tokamak with a resonant helical divertor, 12:38380 (R;US)
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
Polarization change of electron cyclotron waves by reflection, 12:38337 (R;US)
**GCA Corp., Bedford, MA (USA). GCA Technology Div.**
NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**General Electric Co., San Jose, CA (USA). Nuclear Energy Business Operations**
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)
**General Electric Co., Schenectady, NY (USA)**
Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report, 12:36754 (R;US)
**General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center**
X-ray Computed Tomography of coal: Final report, 12:36299 (R;US)
**General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.**
Improvement in accuracy of prediction of electrical machine constants and generator models for subsynchronous resonance conditions: Volume 3, Development and benefit assessment of finite-element-based saturation model: Final report, 12:36753 (R;US)
**General Motors Proving Ground, Milford, MI (USA)**
Application for certification 1987 model year light-duty vehicles - General Motors, 12:37175 (R;US)
**Geneva Univ. (Switzerland)**
Characterization of evacuated collectors, arrays, and collection subsystems: A report of Task 6: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36703 (R;FR)
**Geneva Univ. (Switzerland). Dept. de Physique de la Matiere Condensee**
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)

**Geological Survey, Reston, VA (USA)**
Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986, 12:36312 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986, 12:36313 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, March 15, 1986-June 15, 1986, 12:36314 (R;US)
**George Washington Univ., Washington, DC (USA). Dept. of Physics**
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)
**Georgia Inst. of Tech., Atlanta (USA). Dept. of Chemical Engineering**
Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
**Geotechnics, Inc., Columbus, OH (USA)**
Gas pressure and concentration gradients at the top of a landfill, 12:37824 (R;US)
**Geraghty and Miller, Inc., Oak Ridge, TN (USA)**
Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)
Monitor well installation at K-1407-B and K-1407-C surface impoundments at the Oak Ridge Gaseous Diffusion Plant, 12:36517 (R;US)
**Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)**
List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: October 1-December 31, 1986. Progress report, 12:36830 (R;DE;In German)
**Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)
Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)**
Experimental tumour therapy. 1985 report. Report on the cooperation between the Institute of Radiation Biology of the University of Munich and the Institute for Radiation Biology of the Society for Radiation and Environmental Research, Neuherberg, 12:37903 (R;DE;In German)
**Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)**
Documentation of publications on the subject of forest damage. As of July 1986, 12:37958 (R;DE;In German)
**GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)**
Agreement of model investigations of the critical heat flux in fuel element clusters, 12:36809 (R;DE;In German)
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik**
Agreement of model investigations of the critical heat flux in fuel element clusters, 12:36809 (R;DE;In German)
**GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik**
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**Glasgow Univ. (UK)**
Excited lepton search, 12:38116 (R;DE)
**Global Geochemistry Corp., Canoga Park, CA (USA)**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Goettingen Univ. (Germany, F.R.). Fachbereich Wirtschaftswissenschaften**
Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR)**
Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
**Groenlands Fiskeri- og Miljoeundersoegelser, Copenhagen (Denmark)**
Reindeer investigations prior to the prospective hydroelectric power project Kangerluarsunnguaq/Buksefjord Nuuk/Godthaab 1984-1985, 12:36618 (R;DK;In Danish)
**Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)**
Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)
**Groenlands Tekniske Organisation, Copenhagen (Denmark)**
Complementary preliminary investigastions. Hydroelectric power. Paakitsup Akuliarusersua, Fall 1986, 12:36611 (R;DK;In Danish)
Preliminary investigation hydroelectric power 1984. Power plant technology. Part report 1, Iterlaa Paamiut/Frederikshaab, 12:36614 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Text, 12:36612 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Supplement, 12:36613 (R;DK;In Danish)
**Gulf Coast Research Lab., Ocean Springs, MS (USA)**
Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout, 12:37836 (R;US)
**G2vanTel Ltd., Albuquerque, NM (USA)**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)

## H

**Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik**
Excited lepton search, 12:38116 (R;DE)
NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Hanford Engineering Development Lab., Richland, WA (USA)**
1986 evaluation of delayed-neutron emission probabilities, 12:38245 (R;US)
CLEO: A knowledge-based refueling assistant at FFTF, 12:36815 (R;US)
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)
Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)
Elastic creep-fatigue evaluation for ASME [American Society of Mechanical Engineers] code, 12:37505 (R;US)
Performance of refractory alloy-clad fuel pins, 12:36788 (R;US)
Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
Transient survivability of LMR oxide fuel pins, 12:36820 (R;US)
**Hannover Univ. (Germany, F.R.). Inst. fuer Theoretische Physik**
Strong CP problem and the visibility of invisible axions, 12:38156 (R;DE)
**Harry Diamond Labs., Adelphi, MD (USA)**
Angular-momentum theory applied to interactions in solids. Summary progress report, 12:38293 (R;US)
Field dependence of geminate recombination in a dielectric medium. Final report, October 1974-September 1975, 12:37280 (R;US)

**Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences**
The theory of high energy collision processes: Technical progress report, January 1, 1986 through December 31, 1986, 12:38162 (R;US)
**Hawaii Univ., Hilo (USA)**
Geothermal research at the Puna Facility, 12:36731 (R;US)
**Hawaii Univ., Honolulu (USA)**
Research in planetary studies and operation of the Mauna Kea Observatory. Semiannual progress report, January-December 1986, 12:38063 (R;US)
**Heat Exchanger Systems, Inc., Boston, MA (USA)**
Recommended practices for operating and maintaining steam surface condensers: Final report, 12:36752 (R;US)
**Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet**
Effects of environmental factors (food, heavy metals) on teleostean hepatocytes, 12:37986 (R;DE;In German)
Uptake and distribution of heavy metals in annelidae, with particular regard to limnic tubificides (oligochaeta), 12:37987 (R;DE;In German)
**Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.**
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Heist Engineering Corp., Wilmington, NC (USA)**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
**Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering**
Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Hiroshima Univ. (Japan). Dept. of Physics**
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
**Hoare Lea and Partners, Bristol (UK)**
Geothermal aquifer studies. Heat pump study - preliminary review. Summary and recommendations, 12:36728 (R;GB)
Geothermal report. Low temperature radiator systems. Stage 1. Acquisition and collation of design data, 12:36727 (R;GB)
Heat loads in Great Grimsby. An analysis of the practicalities and economics of a hypothetical geothermal scheme, 12:36730 (R;GB)
Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes, 12:36729 (R;GB)
**Holt Associates, Inc., Fairfax, VA (USA)**
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)
**Horne (Charles P.), Inc., Orinda, CA (USA)**
IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0, 12:36814 (R;US)
**Howard Univ., Washington, DC (USA). Dept. of Chemistry**
The spectroscopy and structure of novel high energy-high density compounds: Final progress report, May 1, 1985-July 31, 1986, 12:37391 (R;US)
**Howard Univ., Washington, DC (USA). Dept. of Mechanical Engineering**
Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure, 12:36492 (R;US)
**Howard Univ., Washington, DC (USA). School of Engineering**
Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986, 12:36312 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986, 12:36313 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, March 15, 1986-June 15, 1986, 12:36314 (R;US)
**Hughes Aircraft Co., Long Beach, CA (USA)**
Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1, 12:36647 (R;US)
**Hughes Research Labs., Malibu, CA (USA)**
Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987, 12:38091 (R;US)
**Hydro Geo Chem., Inc., Tucson, AZ (USA)**
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)

## I

**Idaho Dept. of Fish and Game, Boise (USA). Program Coordination Bureau**
Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual, 12:37834 (R;US)
**Illinois Inst. of Tech., Chicago (USA)**
Enhanced oil recovery through in-situ generated surfactants augmented by chemical injection: First annual report for the period October 1985-September 1986, 12:36380 (R;US)
**Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering**
Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)
**Illinois State Geological Survey, Champaign (USA)**
Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: results of the Fall 1984 test-drilling program. Environmental geology notes, 12:37562 (R;US)
**Illinois Univ., Chicago (USA). Dept. of Physics**
Unorthodox lattice fermion derivatives and their shortcomings, 12:38214 (R;US)
**Illinois Univ., Chicago (USA). Energy Resources Center**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final repcrt], 12:37065 (R;US)
**Illinois Univ., Urbana (USA)**
[Mechanism of proton pumping by bacteriorhodopsin], 12:36625 (R;US)
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)
**Illinois Univ., Urbana (USA). Dept. of Civil Engineering**
Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)

**Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)
**Illinois Univ., Urbana (USA). Dept. of Physics**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
**Illinois Univ., Urbana (USA). Fusion Studies Lab.**
An alpha loss-cone instability in the central cell of a tandem mirror reactor, 12:38325 (R;US)
**Imatran Voima Oy, Helsinki (Finland)**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
**Indiana Univ.-Purdue Univ., Indianapolis (USA)**
Studies of metal ammonia interactions with aromatic substrates: Progress report for the period February 1, 1987 to December 31, 1987, 12:37394 (R;US)
**INSITEC, Danville, CA (USA)**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
**Institute for Defense Analyses, Alexandria, VA (USA)**
Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report, 12:37186 (R;US)
**Institute of Gas Technology, Chicago, IL (USA)**
Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants: Final report for the period October 1982-January 1985, 12:37011 (R;US)
**Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
Numerical simulation of marine seismic source signature and of their interaction. Application to the watergun, 12:38042 (R;FR;In French)
Selective absorption of hydrogen sulfide in carbon dioxide by methyldiethanolamine. Study of a new type of vertical ascending cocurrent flow contactor, 12:37375 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1, 12:36598 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2, 12:36599 (R;FR;In French)
**Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)**
Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field, 12:38015 (TG;US)
**Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)**
Proposal of a simplified model for building thermal behaviour simulation, 12:37069 (R;FR;In French)
**Institutt for Kontinentalsokkelundersoekelser, Trondheim (Norway)**
Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)
**Interagency Advanced Power Group, Fort Belvoir, VA (USA)**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
**Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**International Energy Agency Coal Research, London (UK)**
Flue gas desulphurisation: system performance, 12:37611 (R;GB)
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**International Fuel Cells Corp., South Windsor, CT (USA)**
Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
**INTEVEP, Filial de Petroleos de Venezuela, SA, Caracas**
Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)
**INTEVEP, Filial de Petroleos de Venezuela, SA, Los Teques**
Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes, 12:36377 (R;US)
**Iowa State Univ. of Science and Technology, Ames (USA)**
Electron-tunneling studies of Mo/sub 1-x/Re/sub x/: enhancement of superconductivity by a resonance mode, 12:37275 (D;US)
[Intermediate/high energy probes and the structure of nuclei]: Final report, 12:38270 (R;US)
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
Search for gluonic bound states in high energy proton-proton collisions, 12:38154 (D;US)
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$, 12:38097 (D;US)
**Iowa Univ., Iowa City (USA)**
Plasma physics abstracts, 1 January - 31 December, 1986, 12:38343 (R;US)
**IST Energietechnik G.m.b.H. (Germany, F.R.)**
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Istituto Nazionale di Fisica Nucleare, Pisa (Italy)**
Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)
**Isuzu Motors America, Inc., Southfield, MI**
Application for certification 1987 model year light-duty vehicles - Isuzu, 12:37182 (R;US)

## J

**JBF Associates, Knoxville, TN (USA)**
Risk assessment of soil contamination criteria, 12:37821 (R;US)
**Jet Propulsion Lab., Pasadena, CA (USA)**
PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)
**Johns Hopkins Univ., Baltimore, MD (USA). School of Medicine**
Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)
**Johnson Controls, Inc., Milwaukee, WI (USA)**
Zinc-bromine battery development, 12:36946 (R;US)
**Joint Center for Graduate Study, Richland, WA (USA)**
Graded-bandgap solar cells. Annual report, 1 September 1985-31 August 1986, 12:36620 (R;US)
**Joint Inst. for Nuclear Research, Dubna (USSR)**
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)

## K

**Karlsruhe Univ. (T.H.) (Germany, F.R.)**
Excited lepton search, 12:38116 (R;DE)
**Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie**
Influence of the electrolyte concentration on the absorption of the NO/sub x/ components N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ in aqueous solutions, 12:37526 (R;DE;In German)
**Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik**
Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy, 12:37864 (R;DE;In German)

**Kent State Univ., OH (USA)**
Geologic software for nuclear waste repository studies: A quality assurance program, 12:36529 (R;US)
**Kentucky Univ., Lexington (USA)**
Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)
**Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorhauelemente**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)
**Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)**
Excited lepton search, 12:38116 (R;DE)
**Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen**
Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy, 12:37864 (R;DE;In German)
**Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik**
Annual report on nuclear physics activities. July 1, 1985-June 30, 1986, 12:38231 (R;DE)
**Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung**
Porosity and thermal shock behaviour of ceramic materials, 12:37299 (R;DE;In German)
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
**Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion**
Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. April 1986-September 1986, 12:38381 (R;DE)
**KMS Fusion, Inc., Ann Arbor, MI (USA)**
Alcator pellet evaporation data and the classical flux limit parameter, 12:38339 (R;US)
**Koninklijk Nederlands Meteorologisch Inst., De Bilt**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)
**Korrosionscentralen, Broendby (Denmark)**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)

## L

**Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)**
Exafs and neutron scattering determination of local order in a-Si:H, 12:37330 (R;FR)
**La Jolla Inst., CA (USA)**
Low-energy collisions of excited atoms. Final report, 1 May 1984-30 April 1985, 12:38090 (R;US)
**Lancaster Univ. (UK)**
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Lawrence Berkeley Lab., CA (USA)**
A concept for an advanced computer-based building envelope design tool, 12:37072 (R;US)
A TEM [transmission electron microscopy] study of rhodium on GaAs: Reactions and morphology, 12:37514 (R;US)
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
Congruent reduction and mode conversion in 4-dimensional plasmas, 12:38342 (R;US)
Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O + ^{238}U$, $^{197}Au$, 12:38261 (R;US)
Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues, 12:37073 (R;US)
Energy use test procedures for appliances: A case study of Japanese refrigerators, 12:37027 (R;US)
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)
Enthusiasms and realities in advanced materials, 12:37196 (R;US)
Generation and analysis of stable excavation shapes under high rock stresses, 12:38044 (R;US)
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)
Hydraulic and mechanical properties of natural fractures in low-permeability rock, 12:38043 (R;US)
Interactive software for simulation of high resolution TEM images, 12:38411 (R;US)
Ion beam characterization of thin film metal/GaAs interface reactions, 12:37513 (R;US)
Magnetic susceptibility of AuFe: T/sub g/ and Curie-Weiss parameters, 12:37226 (R;US)
Measurement of electron beam polarization at the SLC, 12:37564 (R;US)
MINC [Multiple Interacting Continua]: An approach for analyzing transport in strongly heterogeneous systems, 12:38037 (R;US)
Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams, 12:38096 (R;US)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
Numerical solution of the Hele-Shaw equations, 12:38103 (R;US)
Permeability of shale at elevated temperature and pressure: Test methodology and preliminary results, 12:36522 (R;US)
Probing the direct step of relativistic heavy ion fragmentation: ($^{12}C$, $^{11}B$+p) at 2.1 GeV/nucleon with C and $CH_2$ targets, 12:38239 (R;US)
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
Quantum chemical methods for massively parallel computers, 12:38308 (R;US)
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)
Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure, 12:37228 (R;US)
Successful molecular beam epitaxy growth and characterization of (110) GaAs/GaAs and (110) AlGaAs/GaAs, 12:37339 (R;US)
The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory, 12:37402 (R;US)
The impacts of balanced and exhaust mechanical ventilation on indoor radon, 12:37712 (R;US)
The magnet lattice of the LBL 1-2 GeV Synchrotron Radiation Source, 12:37561 (R;US)
The standard model and colliders, 12:38218 (R;US)
The structure of GaAs/Si(211) heteroepitaxial layers, 12:37340 (R;US)
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
ZAP and its application to the optimization of synchrotron light source parameters, 12:37560 (R;US)
**Lawrence Livermore National Lab., CA (USA)**
A design procedure to tune the dynamic stiffness of an externally pressurized gas bearing, 12:37469 (R;US)
A high gain free electron laser amplifier design for the Alcator-C tokamak, 12:37518 (R;US)
A study of Economy of Force: An analysis of varying the size of a main and secondary taskforce against a dynamic defense, 12:38400 (R;US)
Adaptive methods for high Mach number reacting flow, 12:37502 (R;US)
An attempt to use high resolution FTIR spectra to determine the population of the various nitrate esters in cellulose nitrate, 12:37381 (R;US)
An evaluation of three temperature controllers for a +-0.002°C application, 12:37467 (R;US)

An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
An overview of copper-laser development for isotope separation, 12:36481 (R;US)
Brittle fracture phenomena: An hypothesis, 12:38048 (R;US)
Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87, 12:37197 (R;US)
Concentrations of radionuclides in fish collected from Bikini Atoll between 1977 and 1984, 12:37852 (R;US)
Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method, 12:37245 (R;US)
Creep of austenitic stainless steels at room temperature, 12:37256 (TG;US)
Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
Demilitarization of conventional ordnance: Priorities for database assessments of environmental contaminants, 12:37584 (R;US)
Direct implicit electromagnetic plasma simulation, 12:38356 (R;US)
Engineering Research Division publication report, Calendar year 1986, 12:37447 (R;US)
Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring, 12:37585 (R;US)
FDAS hardware and firmware description, liquefied gaseous fuels (LGF) data acquisition system: 1987 update, 12:36438 (R;US)
FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements, 12:37244 (R;US)
High average power solid state laser developments at the Lawrence Livermore National Laboratory, 12:37487 (R;US)
Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
Important atomic physics issues for ion beam fusion, 12:38383 (R;US)
Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)
Molecular approaches to the detection of germinal mutations in mammalian organisms, including man, 12:38007 (R;US)
Molecular dynamics studies of energy transfer processes in crystal systems: Annual summary report, 12:38302 (R;US)
Multimegajoule laser design, 12:37486 (R;US)
Near spherical illumination of ion-beam and laser targets, 12:38384 (R;US)
Numerical assessment of high frequency (HF) antennas for shipboard use, 12:37466 (R;US)
Numerical simulation of flow in Brush Creek Valley, Colorado, 12:37728 (R;US)
Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)
Performance analysis of the two-stage light gas gun, 12:37468 (R;US)
Pressure safety training for a large research and development facility, 12:38017 (R;US)
Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from $CO + H_2$ mixtures, 12:36603 (R;US)
Promethium ($Pm^{3+}$) solid state laser, 12:37474 (R;US)
Radiation effects limits on superconducting magnets: Data base for copper stabilizers, 12:37243 (R;US)
Response of a pulse combustor to changes in total ignition delay time, 12:37523 (R;US)
Sensitivity of piping seismic responses to input factors, 12:36931 (R;US)
Symmetry issues in a class of ion beam targets using sufficiently short direct drive pulses, 12:38385 (R;US)
The Livermore Security Console system, 12:36572 (R;US)
Tritium in groundwater at Site 300, 12:37853 (R;US)
X-ray laser world wide progress, 12:37488 (R;US)

**Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry**
Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987, 12:36270 (R;US)

**Lincoln, City of, NE (USA)**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)

**Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering**
Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report, 12:36735 (R;NZ)

**Lincoln Electric System, NE (USA)**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)

**Little (Arthur D.), Inc., Cambridge, MA (USA)**
Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)

**Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)

**Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div.**
Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Annual technical report, November 1985-January 1986, 12:37198 (R;US)

**Los Alamos National Lab., NM (USA)**
A neutron portal monitor for vehicles, 12:36562 (R;US)
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
Cherenkov and transition radiation diagnostics for high energy free-electron lasers, 12:37483 (R;US)
Environmental surveillance at Los Alamos during 1986, 12:37711 (R;US)
Evaluation of materials by the energy yield of an active system, 12:36684 (R;US)
Field-reversed configuration formation and confinement studies on the LSM device, 12:38341 (R;US)
Groundwater chemistry at Yucca Mountain, Nevada, and vicinity, 12:36519 (R;US)
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
High density Z pinch formed from a solid deuterium fiber, 12:38340 (R;US)
High-strain-rate deformation mechanisms in copper and implications for behavior during shock-wave deformation, 12:37223 (R;US)
Hot-spot reaction in unsustained shocks, 12:37582 (R;US)
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)
Influence of peak pressure on the substructure evolution and mechanical properties of shock-loaded 6061-T6 aluminum, 12:37221 (R;US)
Low-thrust rocket trajectories, 12:36821 (R;US)
Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)
New portable hand-held radiation instruments for measurements and monitoring, 12:36561 (R;US)
Optical analysis of high power free electron laser resonators, 12:37484 (R;US)
Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane, 12:37400 (R;US)
Performance correlations for high temperature potassium heat pipes, 12:36803 (R;US)
Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field, 12:38015 (TG;US)
Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure, 12:37228 (R;US)
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
The Cliper Data Acquisition System, 12:37594 (R;US)
The R and D/operational MC and A [materials control and accounting] interface, 12:36560 (R;US)

The shell model for hot-spot ignition, 12:37581 (R;US)
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
Vehicle tracking systems, 12:38396 (R;US)
Whisker reinforced structural ceramics: Progress in the VLS growth and use of long silicon carbide whiskers, 12:37300 (R;US)
Work performance evaluation using the exercising rat model, 12:37959 (R;US)
**Los Alamos Scientific Lab., NM (USA)**
Operation Greenhouse. Scientific director's report of atomic weapon tests at eniwetok, 1951. Annex 9.1. Staff reports. Parts 1 to 4. Annex 9.4. Documentary photography, 12:37590 (R;US)
**Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy**
Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986, 12:38297 (R;US)
**Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center**
Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II, 12:36777 (R;US)
**Lowell Univ., MA (USA). Center for Atmospheric Research**
Preliminary investigation of ionospheric modifucation using oblique-incidence high-power h-f (high-frequency) radio waves. Technical report, 12:38082 (R;US)

## M

**Maine Development Foundation, Augusta (USA)**
Energy related business development project: Final report, 12:38391 (R;US)
**Mainz Univ. (Germany, F.R.)**
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**Manchester Univ. (UK)**
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Manlabs, Inc., Cambridge, MA (USA)**
Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Annual report, 1 March 1986-27 February 1987, 12:37279 (R;US)
**Manville Service Corp., Denver, CO (USA)**
Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing, 12:37139 (R;US)
**Marburg Univ. (Germany, F.R.). Fachbereich 13 Physik**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
**Marine Mammal Commission, Washington, DC (USA)**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
**Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)**
Executive summary of long-range environmental management plans: FY 1987-1993, 12:36960 (R;US)
Resource Management Plan for the Oak Ridge Reservation: Volume 23, Oak Ridge National Environmental Research Park, Research Sites, and State Natural Areas, 12:36963 (R;US)
**Martin Marietta Environmental Systems, Columbia, MD (USA)**
Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report, 12:36762 (R;US)
**Maryland Energy Administration, Annapolis (USA)**
Alternative energy sources guidebook. Final report, 12:37003 (R;US)
**Maryland Univ., College Park (USA)**
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
Short range phenomena, 12:38161 (R;US)
**Maryland Univ., College Park (USA). Dept. of Mathematics**
Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)
**Maryland Univ., College Park (USA). Dept. of Physics and Astronomy**
Nonperturbative extension of the light-front QCD, 12:38267 (R;US)
**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**
Environmental monitoring report for Pantex Plant covering 1986, 12:36550 (R;US)
**Massachusetts General Hospital, Boston (USA)**
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA)**
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**
Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA). Microsystems Research Center**
Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987, 12:38402 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.**
Nuclear reactor and materials science research: Final technical report, May 1, 1985-September 30, 1986, 12:36819 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center**
Alcator pellet evaporation data and the classical flux limit parameter, 12:38339 (R;US)
Fast-wave transmission and reflection in ion-cyclotron heating, 12:38328 (R;US)
Modeling of ICRH experiments in the Tara tandem mirror, 12:38327 (R;US)
Modification of tokamak ballooning stability boundaries by alpha populations, 12:38323 (R;US)
Studies of the regime of improved particle and energy confinement following pellet injection into Alcator C, 12:38326 (R;US)
**Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics**
Measurements of amplification and phase shift (wave refractive index) in a free-electron laser, 12:37472 (R;US)
**Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)**
Excited lepton search, 12:38116 (R;DE)
**Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik**
Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)
**Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)**
Investigation of density fluctuations in the edge region of the divertor tokamak ASDEX, 12:38338 (R;DE;In German)
**McDonnell Aircraft Co., St. Louis, MO (USA)**
Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)
**Mercedes-Benz of North America, Inc., Montvale, NJ**
Application for certification 1987 model year light-duty vehicles - Mercedes-Benz, 12:37176 (R;US)
**Michigan State Univ., East Lansing (USA)**
Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Michigan Technological Univ., Houghton (USA). Inst. of Materials Processing**
Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87, 12:36236 (R;US)
**Michigan Univ., Ann Arbor (USA). Biological Station**
Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)
**Ministere de la Qualite de la Vie, 75 - Paris (France)**
Study of fog formation and developments on the industrial plants at Lacq (France). Role of condensation nuclei, 12:37608 (R;FR;In French)
**Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)

**Mississippi State Univ., Mississippi State (USA). MHD Energy Center**
Particle evolution in MHD systems, 12:37005 (R;US)
**Mississippi Univ., University (USA). Dept. of Biology**
Biodegradation and bioconversion of coals by fungi: Technical report No. 7 for the period March 1, 1987-May 31, 1987, 12:36315 (R;US)
**Missouri Univ., Columbia (USA). Dept. of Chemistry**
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
**Missouri Univ., Columbia (USA). Research Reactor Facility**
Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report], 12:38292 (R;US)
**Mitre Corp., McLean, VA (USA)**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**Mitsubishi Jukogyo K.K., Tokyo (Japan)**
System for removing contaminated surface layers, 12:36807 (TG;US)
**Mitsubishi Motors Corp., Tokyo (Japan)**
Application for certification 1987 model year heavy-duty engines - Mitsubishi Motors corporation, 12:37171 (R;JP)
**Monsanto Research Corp., Miamisburg, OH (USA). Mound**
A measurement control study for tritium gas, 12:36563 (R;US)
Mechanical testing of carbon foam, 12:37341 (R;US)
Single zone control systems, 12:37074 (R;US)
The application of variable explosive chamber testing to actuator testing, 12:37583 (R;US)
**Montana State Univ., Bozeman (USA)**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Montana Univ., Missoula (USA). Wood Chemistry Lab.**
Kinetics of chemisorption and gasification reactions of carbon for evaluation of the role of electron-transfer processes. Annual report, January-December 1986, 12:36460 (R;US)
**Myrias Research Corp., Edmonton, Alberta (Canada)**
An optical model analysis of $^{16}O + ^{12}C$ elastic scattering at E/A = 94 MeV, 12:38266 (R;US)

## N

**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**
Investigation of PTFE transfer films by infrared emission spectroscopy and phase-locked ellipsometry, 12:37344 (R;US)
Shot peening for Ti-6Al-4V alloy compressor blades, 12:37229 (R;US)
Status of commercial fuel cell powerplant system development, 12:37012 (R;US)
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: an initial study, 12:37346 (R;US)
Superalloy resources: Supply and availability, 12:37230 (R;US)
**National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center**
Algorithm implementation on the Navier-Stokes computer, 12:37495 (R;US)
Baseline tensile tests of composite materials for LDEF (Long duration exposure facility) exposure, 12:37342 (R;US)
Remarks on the stability analysis of reactive flows, 12:37442 (R;US)
Simplified method for determining heat of combustion of natural gas, 12:36462 (R;US)
Solar power absorption in a glass tube, 12:36704 (R;US)
**National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center**
Statistical aspects of solar flares, 12:38062 (R;US)
**National Aeronautics and Space Administration, Washington, DC (USA)**
Kinetic model for the vibrational energy exchange in flowing molecular gas mixtures. Ph.D. Thesis, 12:37491 (TG;US)
Theoretical and experimental investigations of ignition, combustion and expansion processes of hypergolic liquid fuel combinations at gas temperatures up to 3000 deg K. Thesis - Rhein-Westfalia Technical Coll., 1967, 12:37441 (R;US)
**National Bureau of Standards, Boulder, CO (USA)**
Transport critical-current characteristics of $Y_1Ba_2Cu_3O/sub\ x/$, 12:37288 (R;US)
**National Bureau of Standards, Washington, DC (USA)**
Development of the NBS $^{10}Be/^{9}Be$ isotopic standard reference material, 12:37577 (R;US)
**National Bureau of Standards, Washington, DC (USA). Chemical Kinetics Div.**
Pulse radiolytic studies of inter- and intramolecular electron transfer processes: Progress report, 12:37434 (R;US)
**National Bureau of Standards, Washington, DC (USA). Thermophysics Div.**
Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report, 12:36725 (R;US)
**National Center for Atmospheric Research, Boulder, CO (USA)**
Procedures for reduction of Fe XII 10747 A coronal emission-line polarization observations. Technical note, 12:38064 (R;US)
**National Council on Radiation Protection and Measurements, Bethesda, MD (USA)**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)
Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements, 12:37877 (R;US)
**National Energy Information Center, Washington, DC (USA)**
Power plant report, monthly cumulative for 1987 (EIA-759). Data file, 12:36999 (R;US)
**National Geophysical Data Center, Boulder, CO (USA)**
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)**
Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)
Fence: where the community and the workplace meet, 12:37889 (R;US)
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)
Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)
Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)

Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)
Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)
Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington, 12:37629 (R;US)
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma, 12:37675 (R;US)
Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York, 12:37689 (R;US)
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)
Mortality among uranium enrichment workers, 12:36480 (R;US)
NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US`
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the rtecs computer tape. Annual edition, 12:37992 (R;US)
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)

**National Lab. for High Energy Physics, Oho, Ibaraki (Japan)**
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)

**National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA)**
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)

**National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.**
Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo, 12:37671 (R;US)

**National Research Council, Washington, DC (USA). Water Science and Technology Board**
Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report, 12:37845 (R;US)

**National Research Inst. for Metals, Tokyo (Japan)**
The Fermi surface of CeSb, 12:37205 (R;US)

**National Wetlands Research Center, Slidell, LA (USA)**
Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout, 12:37836 (R;US)

**Naval Aerospace Medical Research Lab., Pensacola, FL (USA)**
Evaluation of drugs for prevention of hyperthermia in rats exposed to microwave irradiation. Final report, 1983-1985, 12:38013 (R;US)

**Naval Postgraduate School, Monterey, CA (USA)**
Parametric investigation of soot behavior and other emissions in a gas-turbine combustor. Master's thesis, 12:36461 (R;US)

**Naval Research Lab., Washington, DC (USA)**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)

**Naval Surface Weapons Center, Silver Spring, MD (USA)**
Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)

**New Hampshire Univ., Durham (USA). Dept. of Physics**
High-energy neutral radiations from the sun, 12:38051 (R;US)

**New Mexico State Univ., Las Cruces (USA)**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)

**New Mexico Univ., Albuquerque (USA)**
Shock-modified transition metal ferrites, 12:37348 (R;US)

**New Mexico Univ., Albuquerque (USA). Center for Advanced Studies**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)

**New Mexico Univ., Albuquerque (USA). Dept. of Chemistry**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)

**New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy**
Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides, 12:37304 (R;US)

**New York State Dept. of Health, Albany (USA)**
Radon source rate measurements using multiple perfluorocarbon tracers, 12:37709 (R;US)

**New Zealand Dairy Research Inst., Palmerston North**
The use of recovered heat for preheating air to spray driers, 12:37147 (R;NZ)

**New Zealand Energy Research and Development Committee, Auckland**
Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation, 12:36954 (R;US)
Four futures: energy implications of social and economic change, 12:36952 (R;NZ)
Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report, 12:36735 (R;NZ)

**Nijverheidsorganisatie TNO, Apeldoorn (Netherlands)**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)

**Nissan Motor Co. Ltd., Yokohama (Japan)**
Application for certification 1987 model year light-duty vehicles - Nissan, 12:37177 (R;JP)

**Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)

**Norges Landbrukshoegskole, Aas**
Alternative energy supply systems for lettuce production in greenhouses, 12:37145 (R;NO;In Norwegian)

**Norges Teknisk-Naturvitenskapelige Forskningsraad, Oslo. Program for Oljevernberedskap**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)

**Norsk Inst. for Luftforskning, Lillestroem**
Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation, 12:37621 (R;NO;In Norwegian)

**Norsk Inst. for Vannforskning, Oslo**
Long term effects of oil on marine benthic communities in enclosures, 12:36420 (R;NO)
RAIN project. Annual report for 1984, 12:37622 (R;NO)

**North Carolina State Univ., Raleigh (USA). Dept. of Marine, Earth and Atmospheric Sciences**
Analysis and evaluation of statistical coastal fumigation models, 12:37640 (R;US)

**North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering**
Antiphase boundaries in $\beta$-SiC thin films, 12:37289 (R;US)
Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide, 12:37281 (R;US)

**North Carolina State Univ., Raleigh (USA). Dept. of Plant Pathology**
Effects of acid precipitation on plant diseases, 12:37999 (R;US)

**North of Scotland Coll. of Agriculture, Aberdeen (UK). Engineering Div.**
Report on anaerobic digestion of dairy cattle wastes to October 1981, 12:36585 (R;GB)

**Northrop Services, Inc., Corvallis, OR (USA)**
EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)
**Northrop Services, Inc., Research Triangle Park, NC (USA)**
Remote measurement of sulfur dioxide emissions using an ultraviolet-light-sensitive video system, 12:37644 (R;US)
**Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy**
Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method, 12:37245 (R;US)
**Notre Dame Univ., IN (USA)**
Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions, 12:36824 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA)**
Indexes to Nuclear Regulatory Commission issuances, July-September 1986, 12:36792 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
Pipe-to-pipe impact program, 12:36778 (R;US)
Seismic safety research program plan, 12:36834 (R;US)
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety**
Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986, 12:36804 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review, 12:36923 (R;US)
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services**
Nuclear Regulatory Commission issuances, 12:36793 (R;US)
Title list of documents made publicly available: April 1-30, 1987, 12:36791 (R;US)
Title list of documents made publicly available: February 1-28, 1987, 12:36790 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis**
Evaluation of protective action risks, 12:36554 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety**
MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Risk Analysis and Operations**
Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records**
NRC Regulatory Agenda: Quarterly report, January-March 1987, 12:36794 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight**
GASPAR II: Technical reference and user guide, 12:37931 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management**
Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data**
Licensee event report (LER) compilation for month of January 1987, 12:36795 (R;US)
Licensee event report (LER) compilation for month of February 1987, 12:36796 (R;US)
Licensee event report (LER) compilation: For month of April 1987, 12:36797 (R;US)
NRC Incident Response Plan, 12:36833 (R;US)
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
Report to the US Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data, 1986, 12:36836 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement**
Enforcement actions: Significant actions resolved: Quarterly progress report, October-December 1986, 12:36976 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
Technical Specifications, Beaver Valley Power Station, Unit No. 2 (Docket No. 50-412): Appendix A to License No. NPF-64, 12:36835 (R;US)
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)
Flaw density examinations of a clad boiling water reactor pressure vessel segment, 12:36773 (R;US)
Low-level waste source term evaluation: Review of published modeling and experimental work, and presentation of low-level waste source term modeling framework and preliminary model development: Topical report, 12:36521 (R;US)
**NUS Corp., Gaithersburg, MD (USA)**
Determination of background radiological characteristics within the Palo Duro Basin, Texas: Technical report, 12:37818 (R;US)

## O

**Oak Ridge Associated Universities, Inc., TN (USA)**
Antiphase boundaries in $\beta$-SiC thin films, 12:37289 (R;US)
**Oak Ridge National Lab., TN (USA)**
A method to automate the radiological survey process, 12:37819 (R;US)
A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
A review of the organic geochemistry of shales, 12:36526 (R;US)
Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)
An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
An optical model analysis of $^{16}O + {}^{12}C$ elastic scattering at E/A = 94 MeV, 12:38266 (R;US)
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
Antiphase boundaries in $\beta$-SiC thin films, 12:37289 (R;US)
Application of analytical electron microscopy to design of creep resistant advanced austenitic stainless steels, 12:37210 (R;US)
Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985, 12:37377 (R;US)
Assessment of energy storage concepts for use in pulsed space power systems, 12:36786 (R;US)
Biomedical and Environmental Sciences Programs: Publications 1986, 12:37859 (R;US)
Calculated neutron-induced cross sections for /sup 58,60/Ni from 1 to 20 MeV and comparisons with experiments, 12:38274 (R;US)
Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method, 12:37245 (R;US)
Considerations on a de minimis dose and disposal of exempt concentrations of radioactive wastes, 12:36525 (R;US)

Consolidated Fuel Reprocessing Program: Progress report for period October 1 to December 31, 1986, 12:36488 (R;US)
Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/ $CuO_4$, 12:37291 (R;US)
Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
Development of the NBS $^{10}Be/^{9}Be$ isotopic standard reference material, 12:37577 (R;US)
Diffraction effects from interfaces, 12:37211 (R;US)
Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II, 12:36777 (R;US)
DOE Hazardous Waste Remedial Actions Program: Annual report, FY 1986, 12:36959 (R;US)
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
Effect of infiltration conditions on the properties of SiC/Nicalon composites, 12:37301 (R;US)
Effect of temperature on nondissociative electron attachment to molecules, 12:37388 (R;US)
Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Energy Division annual progress report for period ending September 30, 1986, 12:36750 (R;US)
Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
Evaluation of a digital optical ionizing radiation particle track detector, 12:37568 (R;US)
Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota, 12:37078 (R;US)
Evaluation of power control methods for free-piston Stirling engine driven heat pumps, 12:37025 (R;US)
Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
Flaw density examinations of a clad boiling water reactor pressure vessel segment, 12:36773 (R;US)
Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 12:36523 (R;US)
Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
Ignition physics study group support of the engineering test reactor program, 12:38375 (R;US)
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
Kinetic theory of radiation effects, 12:37207 (R;US)
Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide, 12:37281 (R;US)
Licensee event report (LER) compilation for month of January 1987, 12:36795 (R;US)
Licensee event report (LER) compilation: For month of April 1987, 12:36797 (R;US)
Licensee event report (LER) compilation for month of February 1987, 12:36796 (R;US)
Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/, 12:37294 (R;US)
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
Modification of tokamak ballooning stability boundaries by alpha populations, 12:38323 (R;US)
New buildup factor data for point kernel calculations, 12:38291 (R;US)
Nonlinear dynamics of tearing modes in the reversed field pinch, 12:38332 (R;US)
Notes on the effect of dose uncertainty, 12:37902 (R;US)
Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)
One and two dimensional radiation analysis of the compact ignition tokamak, 12:38369 (R;US)
Oxidation of Ge-implanted silicon, 12:37332 (R;US)
Pellet injector research at ORNL, 12:38372 (R;US)
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
Prediction of the mortality dose-response relationship in man, 12:37901 (R;US)
Preparation of radioactive "mixed" waste samples for measurement of RCRA [Resource Conservation and Recovery Act] organic compounds, 12:37371 (R;US)
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
Production of fine, high-purity, beta SiC powder, 12:37282 (R;US)
Promethium ($Pm^{3+}$) solid state laser, 12:37474 (R;US)
Recent electronic improvements to the Oak Ridge 25URC accelerator, 12:37547 (R;US)
Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary, 12:37838 (R;US)
Review of the Advanced Toroidal Facility program, 12:38368 (R;US)
Shielding methods for evaluating the versatility of proposed shipping casks, 12:37453 (R;US)
Single-family building retrofit performance monitoring protocol: Data specification guideline, 12:37077 (R;US)
Stopping biological time: The freezing of living cells, 12:37936 (R;US)
Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)
Structural nature of the amorphous-to-crystalline transition in phosphate glasses as studied by liquid chromatography, 12:37331 (R;US)
Subsurface-controlled geological maps for the Y-12 plant and adjacent areas of Bear Creek Valley, 12:38039 (R;US)
Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)
Temporal variation in regulation of production in a pelagic food web model, 12:37833 (R;US)
Testing of developmental ceramic materials in diesel engine combustion chambers, 12:37160 (R;US)
Testing thermal insulations with a thin-heater apparatus, 12:37023 (R;US)
Tests of a high-power folded waveguide coupler for ICRF heating, 12:38371 (R;US)
The determination of chlorophenoxy acid herbicides by liquid chromatography using carbon-14 tracers, 12:37372 (R;US)
The economic feasibility of plastics recycling, 12:37129 (R;US)
The evaporative vector: Homogeneous systems, 12:38094 (R;US)
The ignition physics study group supports the compact ignition tokamak and engineering test reactor programs, 12:38376 (R;US)
The influence of N-ion irradiation on superconducting TiN, 12:37212 (R;US)
The solubilization of low-ranked coals by microorganisms, 12:36295 (R;US)
The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)
Thermal noise in linear passive multiports, 12:37512 (R;US)
Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms, 12:36296 (R;US)

**Oak Ridge Y-12 Plant, TN (USA)**
Statistically stable branch method for improving accountability and control, 12:36573 (R;US)

**Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Umweltplanung**
Bilateral information meeting Hungary-Austria, subject 'forest decline', 12:37989 (R;DE;In German)
Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)

**Office of Science and Technology Policy, Washington, DC (USA)**
Case for strategic defense: an option for a world disarmed, 12:37595 (R;US)

**Office of Technology Assessment (U.S. Congress), Washington, DC**
Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment), 12:36973 (R;US)
Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment), 12:36974 (R;US)

**Office of Water Research and Technology, Washington, DC (USA)**
Mount St. Helens: the aftermath, 12:37673 (R;US)
**Ontario Hydro, Toronto (Canada). Research Center**
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**Opel (A.) A.G., Ruesselsheim (Germany, F.R.)**
Automobile engines. Design and function, 12:37163 (R;DE;In German)
**Oregon Univ., Eugene (USA). Dept. of Physics**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
**Osaka Univ. (Japan)**
$\nu$/sub $\mu$/e → $\nu$/sub $\mu$/e and $\nu$/sub $\mu$/p → $\nu$/sub $\mu$/p, 12:38114 (R;US)
**Osaka Univ., Toyonaka (Japan). Dept. of Physics**
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
**Otto (R.G.) and Associates, Key West, FL (USA)**
Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)
**Owens-Illinois, Inc., Toledo, OH (USA)**
Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)

## P

**Pacific Marine Environmental Lab., Seattle, WA (USA)**
Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo, 12:37842 (R;US)
**Pacific Northwest Lab., Richland, WA (USA)**
1985 primary heating fuel use and switching: Assessment of the market for conservation in the Northwest: Phase 2, 12:37080 (R;US)
Achieving ultralow background in a germanium spectrometer, 12:37569 (R;US)
Analysis of medium-BTU gasification condensates, June 1985-June 1986, 12:38006 (R;US)
Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document, 12:37816 (R;US)
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)
Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)
Design procedure for sizing a submerged-bed scrubber for airborne particulate removal, 12:37722 (R;US)
Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
GASPAR II: Technical reference and user guide, 12:37931 (R;US)
Geologic software for nuclear waste repository studies: A quality assurance program, 12:36529 (R;US)
Lost conservation opportunities in the Pacific Northwest irrigation sector, 12:37148 (R;US)
Microdosimetric basis for exposure limits, 12:37932 (R;US)
PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)
Performance issues in solar thermal energy transport systems, 12:36655 (R;US)
Pilot-scale grout production test with a simulated low-level waste, 12:36527 (R;US)
Pipe-to-pipe impact program, 12:36778 (R;US)
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)
Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring, 12:36555 (R;US)
Product analysis from direct liquefaction of several high-moisture biomass feedstocks, 12:36591 (R;US)
Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas, 12:36494 (R;US)
Rod consolidation of RG and E's [Rochester Gas and Electric Corporation] spent PWR [pressurized water reactor] fuel, 12:36493 (R;US)
Spent fuel performance in geologic repository environments, 12:36530 (R;US)
Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste, 12:36528 (R;US)
Technology diffusion of energy-related products in residential markets, 12:37081 (R;US)
The application of expert systems to the analysis of logic trees, 12:38016 (R;US)
The value of conservation in the Pacific Northwest, 12:37014 (R;US)
Thermal Energy Storage Evaluation Program: 1986 annual report, 12:36939 (R;US)
Trace rare earth element analysis in briny groundwaters, 12:38045 (R;US)
Uranium in selected endorheic basins as partial analogue for spent fuel behavior in salt, 12:36478 (R;US)
Wet scavenging processes, 12:37704 (R;US)
**Pacific Northwest Lab., Richland, WA (USA). Salt Repository Project**
Data report on static leach tests with Savannah River Laboratory defense waste glass in PBB1 brine at 90°C: Salt Repository Project, 12:36531 (R;US)
**PAR Enterprises, Inc., Fairfax, VA (USA)**
Cost/performance analysis of high temperature waste heat recovery equipment: Final report, 12:37136 (R;US)
**Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides**
Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)
**Parsons (Ralph M.) Co., Pasadena, CA (USA)**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Patuxent Wildlife Research Center, Laurel, MD (USA)**
Mercury hazards to fish, wildlife, and invertebrates: a synoptic review, 12:37998 (R;US)
**Peace Corps, Washington, DC (USA). Information Collection and Exchange**
Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation), 12:36590 (R;US)
**Pechan (E.H.) and Associates, Inc., Springfield, VA (USA)**
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences**
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Pennsylvania State Univ., University Park (USA). Dept. of Chemistry**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering**
Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
**Pennsylvania State Univ., University Park (USA). Dept. of Mechanical Engineering**
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering**
Evaluation of protective action risks, 12:36554 (R;US)
**Pennsylvania State Univ., University Park (USA). Materials Research Lab.**
Spectroscopic investigations of glass structure: Final report for the period April 1, 1984-December 31, 1986, 12:37334 (R;US)
**Pennsylvania Univ., Philadelphia (USA)**
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)

**Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry**
Structure of yeast inorganic pyrophosphastase: A progress report, 12:37861 (R;US)
**Pennsylvania Univ., Philadelphia (USA). Dept. of Physics**
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
**Pittsburgh Univ., PA (USA)**
An experimental study of heat of immersion of coal, 12:36292 (R;US)
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
**Pittsburgh Univ., PA (USA). School of Engineering**
Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 7, March 1, 1987-May 31, 1987, 12:36269 (R;US)
**Planning and Human Systems, Inc., Washington, DC (USA)**
Atomic power in space: A history, 12:36787 (R;US)
**Politechnika Warszawska (Poland)**
Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)
**Poly Solar, Inc., Garland, TX (USA)**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)
**Pratt and Whitney Aircraft, East Hartford, CT (USA)**
Advanced composite combustor structural concepts program. Final Report, 12:37343 (R;US)
**Price Waterhouse, Pittsburgh, PA (USA)**
Competition: Pressures for change: Final report, 12:36996 (R;US)
**Princeton Univ., NJ (USA). Plasma Physics Lab.**
An algorithm for the calculation of 3-D ICRF [Ion Cyclotron Range of Frequencies] fields in tokamak geometry, 12:38345 (R;US)
Eigenmode analysis of compressional waves in the magnetosphere, 12:38350 (R;US)
Energy confinement and profile consistency in TFTR, 12:38351 (R;US)
Gyrokinetic particle simulation of ion temperature gradient drift instabilities, 12:38353 (R;US)
High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics, 12:38347 (R;US)
Ideal MHD stability properties of pressure-driven modes in low shear tokamaks, 12:38348 (R;US)
Impurity and particle transport and control in TFTR, 12:38382 (R;US)
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence, 12:38349 (R;US)
Tokamak physics studies using x-ray diagnostic methods, 12:38346 (R;US)
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)
Vectorizing and macrotasking Monte Carlo neutral particle algorithms, 12:38352 (R;US)
**Professional Analysis, Inc., Oak Ridge, TN (USA)**
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**Purdue Univ., Lafayette, IN (USA). Water Resources Research Center**
Hydrologic models of surface-mined areas. Technical report, 12:36341 (R;US)

## Q

**Queen Mary Coll., London (UK)**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Queen Mary Coll., London (UK). School of Mathematics**
Orbit extension method for finding unstable orbits, 12:38333 (R;US)
**Queen's Univ., Kingston, Ontario (Canada). Dept. of Chemistry**
Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory, 12:37387 (R;US)

## R

**Radian Corp., Austin, TX (USA)**
National Air Toxics Information Clearinghouse (NATICH) data base user's guide for data entry and editing. Interim report, 12:37641 (R;US)
**Radian Corp., Research Triangle Park, NC (USA)**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)
**Regis Coll., Weston, MA (USA)**
Magnetosphere-ionosphere interaction studies. Final report, 11 July 1980-30 June 1984, 12:38083 (R;US)
**Rensselaer Polytechnic Inst., Troy, NY (USA)**
Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**Research Triangle Inst., Research Triangle Park, NC (USA)**
Monitoring before and after radon mitigation, 12:37719 (R;US)
Second performance audit of inspection and maintenance calibration gases, 12:37637 (R;US)
**RE/SPEC, Inc., Albuquerque, NM (USA)**
The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project, 12:38046 (R;US)
**RE/SPEC, Inc., Rapid City, SD (USA)**
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand, 12:36535 (R;US)
**Rice Center, Houston, TX (USA)**
Non-federal funding for transit systems: state-of-the-art case analyses. Final report, 1983-1985, 12:37099 (R;US)
**Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.**
High energy physics: Progress report, 12:38121 (R;US)
**Rochester Univ., NY (USA). Nuclear Structure Research Lab.**
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)
**Rockefeller Univ., New York (USA)**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
[Some basic research problems related to energy: Progress report], 12:38101 (R;US)
**Rock Mechanics Ltd., Falmouth (UK)**
Cleethorpes geothermal exploration borehole. Drilling and testing programme. General report , 12:36722 (R;GB)
**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**
Acoustic emission produced by deformation of metals and alloys, 12:37233 (R;US)
Annual Environmental Monitoring report, January through December 1986, 12:37723 (R;US)
Aqueous methods for recovery of plutonium from pyrochemical residues, 12:36490 (R;US)
Design and evaluation of plutonium electrorefining cells, 12:36484 (R;US)
Maintaining occupational review programs using the flow Gemini system, 12:37933 (R;US)
Permeation tubes for dynamic mass spectrometry calibration, 12:37379 (R;US)
[Small scale direct oxide reduction (DOR) experiments], 12:36491 (R;US)
System for removing contaminated surface layers, 12:36807 (TG;US)
Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate, 12:37232 (R;US)
**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)

**Rockwell International Corp., Thousand Oaks, CA (USA). Science Center**
Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Rogalandsforskning, Stavanger (Norway)**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)
**Rolls Royce Motors, Inc., Lyndhurst, NJ (USA)**
Application for certification 1987 model year light-duty vehicles - Rolls Royce, 12:37179 (R;US)
**Rome Univ. (Italy)**
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems, 12:38219 (R;IT)
**Rowett Research Inst., Aberdeen (UK)**
Report on anaerobic digestion of dairy cattle wastes to October 1981, 12:36585 (R;GB)
**Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Technology**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)

## S

**Sacramento Municipal Utility District, CA (USA)**
SMUDPV2 quarterly performance report IV for the period January through March 1987, 12:36649 (R;US)
**Sandia National Labs., Albuquerque, NM (USA)**
A device to measure friction coefficients and contact resistance inside a scanning Auger microscope, 12:37578 (R;US)
A finite element material model for microfracture-damaged brittle rock, 12:38047 (R;US)
A natural taxonomy for digital information authentication schemes, 12:38399 (R;US)
A new constitutive model for fragmentation of rock under dynamic loading, 12:36467 (R;US)
A performance evaluation of personnel identity verifiers, 12:36567 (R;US)
A strain-rate-dependent spall mechanism transition in metals, 12:37242 (R;US)
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
An analytical model for Rayleigh-Taylor instability in solids, 12:38301 (R;US)
An experimental and analytical evaluation of a Type B radioactive transport container, 12:37460 (R;US)
Analysis of a proposed NNWSI exploratory shaft slot test for tuff response, 12:36537 (R;US)
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
Authentication codes that permit arbitration, 12:38398 (R;US)
Base technology development enhances state-of-the-art in meeting performance requirements, 12:37465 (R;US)
Characterization of accelerometer mountings in shock environments, 12:37579 (R;US)
Comparison study of search algorithms and data base libraries for compound identification from mass spectral data, 12:37380 (R;US)
Confined volume blasting experiments: Description and analysis, 12:36466 (R;US)
Coupling boundary integral and finite element formulations for nonlinear halfspace problems, 12:38412 (R;US)
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
Development of CABAL [calcium-boro-aluminate] glasses for use in lithium ambient-temperature batteries, 12:36945 (R;US)
Dynamic quasi-isentropic compression of tungsten, 12:37241 (R;US)
Electronic structure of boron and boron rich borides, 12:37239 (R;US)
Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)
Exploratory Battery Technology Development and Testing report for 1985, 12:36944 (R;US)
Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)
GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature (T > 300°C), power electronic applications, 12:37517 (R;US)
Heat transfer to large objects in large pool fires, 12:37464 (R;US)
Insertions using geometric analysis and hybrid force-position control on a PUMA 560 with VAL II, 12:37463 (R;US)
Kevlar/epoxy laminates: Mechanical response of as-fabricated and shock-loaded materials, 12:37350 (R;US)
Liquid metal thermal electric converter, 12:36657 (R;US)
MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
Metastable phase boundaries of quasicrystalline phases, 12:37240 (R;US)
Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides, 12:37304 (R;US)
Modeling of shock-induced solid state chemistry, 12:38300 (R;US)
Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1, 12:36647 (R;US)
Neutron spectrum adjustment with SANDII using arbitrary trial functions, 12:36800 (R;US)
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)
On ion induced hard errors in dielectric structures, 12:37516 (R;US)
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review, 12:36923 (R;US)
Random control at $n^2$ points using n shakers, 12:37508 (R;US)
Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)
Reliable communications in a network with unreliable key distribution centers, 12:36565 (R;US)
Research in lost circulation control for geothermal wells, 12:36726 (R;US)
Robotic handling of spent fuel shipping casks: Preliminary assessment of cask design impacts and technology development needs, 12:37461 (R;US)
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project, 12:37822 (R;US)
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
Semi-automated reviewing station for IAEA [International Atomic Energy Agency] optical surveillance data, 12:36568 (R;US)
Shock-modified transition metal ferrites, 12:37348 (R;US)
Silicate precursors: chemical kinetics, 12:37407 (R;US)
SIR-1: An autonomous mobile sentry robot, 12:36570 (R;US)
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
Small-Scale Seal Performance Test Series "A" thermal/structural data through the 180th day, 12:37347 (R;US)
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986, 12:36540 (R;US)
SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project, 12:36539 (R;US)
The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
The evolution of interior intrusion detection technology at Sandia National Laboratories, 12:36566 (R;US)
The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)

The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project, 12:38046 (R;US)
The testing of catalysts for alkane activation, 12:36600 (R;US)
The Thermal Flash Protection System, low pass filter JN175666A1, 12:37515 (R;US)
The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices, 12:37349 (R;US)
Thermal expansion of low-density microcellular foams, 12:37351 (R;US)
Thermal measurements in large pool fires, 12:37462 (R;US)
Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel, 12:36534 (R;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
Vault demonstration program, 12:37596 (R;US)
VAWT stochastic wind simulator, 12:36742 (R;US)
Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
Water pumping: The solar alternative, 12:36648 (R;US)
Zinc-bromine battery development, 12:36946 (R;US)

**Sandia National Labs., Livermore, CA (USA)**
An analysis of power production performance for solar one, the 10 MWe Solar Thermal Central Receiver Pilot Plant, 12:36659 (R;US)

**Sao Paulo Univ. (Brazil). Inst. de Fisica**
Spontaneous ideas about the speed of light, 12:38395 (R;BR)

**Savannah River Lab., Aiken, SC (USA)**
Canyon solvent cleaning, 12:36485 (R;US)
Canyon solvent cleaning with solid adsorbents, 12:36486 (R;US)
Comparison of laboratory and plant mixer-settlers, 12:36487 (R;US)
Environmental information document: New hazardous and mixed waste storage/disposal facilities at the Savannah River Plant, 12:36514 (R;US)
Environmental information document: Y Area, 12:36549 (R;US)
F-Area Seepage Basins: Environmental information document, 12:37826 (R;US)
Lubication and surface finish of extruded aluminum, 12:37218 (R;US)
Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste, 12:36510 (R;US)
[Plutonium accumulation in tank (DPSPU-85-272-35)], 12:36556 (R;US)
Recovery of transuranics from process residues, 12:36513 (R;US)
Remote sensing at Savannah River, 12:37825 (R;US)
Risk assessment of soil contamination criteria, 12:37821 (R;US)
Transport of organic contaminants in coastal plain sediments, 12:37808 (R;US)
Using operating experience and a cause coding tree to identify improvements for nuclear process control, 12:36825 (R;US)

**School of Aerospace Medicine, Brooks AFB, TX (USA)**
Metabolic effects of microwave radiation and convection heating on human mononuclear leukocytes. Final report, January 1985-May 1986, 12:38012 (R;US)

**Schweizerischer Ingenieur- und Architekten-Verein, Zurich**
Heating days in Switzerland. Recommendation. Version 1982, 12:37724 (R;DE;In German)

**Science Applications, Inc., Oak Ridge, TN (USA)**
System design description for the CPDF [Centrifuge Plant Demonstration Facility] electric power system: SDD-9, 12:36479 (R;US)
Temporal variation in regulation of production in a pelagic food web model, 12:37833 (R;US)

**Science Applications International Corp., Arlington, VA (USA). Center for Seismic Studies**
Technical report for the period 1 October-31 December 1986, 12:37597 (R;US)

**Science Applications International Corp., Las Vegas, NV (USA)**
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)

**Science Applications International Corp., Los Altos, CA (USA)**
Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)

**Science Applications International Corp., McLean, VA (USA)**
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)

**S-Cubed, San Diego, CA (USA)**
Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986, 12:36540 (R;US)

**SINTEF, Trondheim (Norway)**
Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)
Wild-life studies in the Alta watercourse. Survey report for 1982-1984, 12:37766 (R;NO;In Norwegian)

**SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics**
Mechanical interactions of rough surfaces: Quarterly progress report for period December 31, 1986 to March 29, 1987, 12:37296 (R;US)
The joint effect of surface microtopography and near-surface structure on microcontact conditions: Quarterly progress report for period 31 March 1987 to 30 June 1987, 12:37295 (R;US)

**Skibsteknisk Laboratorium, Lyngby (Denmark)**
Construction and testing of a Darrieus wind turbine. Demonstration plant, 12:36741 (R;DK;In Danish)
Measurements of power quality for a modern wind turbine, 12:36743 (R;DK;In Danish)

**Smithsonian Astrophysical Observatory, Cambridge, MA (USA)**
Normal incidence x-ray telescope. Semiannual progress report, 1 May 1985-31 October 1986, 12:37566 (R;US)

**Societe Nationale Industrielle Aerospatiale, Cannes (France)**
Concentration principle applied to spaceborne solar arrays. AGORA mission: studies synthesis, 12:36637 (R;FR)

**Society for Industrial and Applied Mathematics, Philadelphia, PA (USA)**
SIAM 1986 national meeting: Final technical report, 12:38102 (R;US)

**Solar Energy Research Inst., Golden, CO (USA)**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)
High-rate deposition of hydrogenated amorphous silicon films and devices, 12:36636 (R;US)
Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)

**Southampton Univ. (UK). Inst. of Sound and Vibration Research**
Noise prediction programme for wind turbines, 12:36738 (R;GB)

**South Carolina Univ., Columbia (USA)**
Achieving ultralow background in a germanium spectrometer, 12:37569 (R;US)

**Southern Co. Services, Inc., Birmingham, AL (USA)**
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)

**Southern Electric International, Birmingham, AL (USA)**
Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report, 12:37609 (R;US)

**Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center**
Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)

**Southern Research Inst., Birmingham, AL (USA)**
Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report, 12:37610 (R;US)

**Squires Labs., Las Cruces, NM (USA). American Solar Products Div.**
Development of an innovative, low-cost solar collector: Final technical report, 12:36685 (R;US)

**SRI International, Menlo Park, CA (USA)**
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987, 12:36584 (R;US)

Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)

**Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)

**Stanford Linear Accelerator Center, Menlo Park, CA (USA)**
An upper limit on the decay $D^0 \rightarrow \mu e$, 12:38148 (R;US)
Beam trajectory acquisition system for the arcs of the Stanford Linear Collider, 12:37555 (R;US)
Design of a wiggler-focused, sheet beam X band klystron, 12:37557 (R;US)
Experimental tests of quantum chromodynamics, 12:38146 (R;US)
Feedback systems in the SLC, 12:37556 (R;US)
Future frontiers for $e^+ e^-$ collisions: physics of SLC and LEP, 12:38145 (R;US)
How to measure $\epsilon'/\epsilon$ with lattice QCD, 12:38224 (R;US)
Introduction to string and superstring theory II, 12:38223 (R;US)
Measurement by phase severance, 12:38309 (R;US)
On the discrete reconciliation of relativity and quantum mechanics, 12:38310 (R;US)
Overview of the standard model, 12:38196 (R;US)
Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look, 12:38147 (R;US)
Some fast beam kicker magnet systems at SLAC, 12:37554 (R;US)
Testing quantum chromodynamics in electroproduction, 12:38197 (R;US)
The decay tau $\rightarrow$ rho nu (and rho $\rightarrow \pi$ eta nu?), 12:38149 (R;US)

**Stanford Telecommunications, Inc., Reston, VA (USA)**
System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1, 12:37580 (R;US)

**Stanford Univ., CA (USA). Dept. of Applied Physics**
Superconducting thin films, composites & junctions. Annual report, 1 October 1985-30 September 1986, 12:37450 (R;US)

**Stanford Univ., CA (USA). Dept. of Computer Science**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)

**Stanford Univ., CA (USA). Dept. of Electrical Engineering**
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)

**Stanford Univ., CA (USA). Petroleum Research Inst.**
Mathematical analysis of single-well tracer test, 12:36383 (R;US)
The comparative economics of thermal recovery projects, 12:36382 (R;US)
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)

**Statens Energiverk, Stockholm (Sweden)**
Chipping, transport and firing of energy forest wood. Practical tests during the winter of 1985/1986, 12:36639 (R;SE;In Swedish)
Combined systems sod peat - milled peat, 12:36344 (R;SE;In Swedish)
Controlling of processes for producing energy carriers by means of biotechnique, 12:36602 (R;SE;In Swedish)
Fuels from agricultural crops. Production estimates, cost of raw products and value of by-products, 12:36638 (R;SE;In Swedish)
Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
Hydrogeological studies of peatlands at Haerjedalen, 12:36345 (R;SE;In Swedish)
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
Soviet energy. Proceedings from an international seminar, 12:36987 (R;SE)
Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades, 12:36757 (R;SE)
Thermal oxidation of waste from wet-dry flue gas desulfurization and reuse of the final product, 12:36766 (R;SE;In Swedish, English and German)

**Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)**
Energy saving by means of mutual adjustment of tractor and tools size, 12:37149 (R;DK;In Danish)

**State Univ. of New York, Binghamton (USA)**
Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86, 12:36266 (R;US)

**State Univ. of New York, Buffalo (USA)**
Optimal partitioning and redundancy removal in computing partial sums. Technical report (Final) December 1985-January 1987, 12:38405 (R;US)

**State Univ. of New York, Stony Brook (USA). Dept. of Physics**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)

**State Univ. of New York, Stony Brook (USA). Research Foundation**
Experimental high energy physics using electromagnetic energy calorimetry: [Progress report], 12:38122 (R;US)

**Stirling Thermal Motors, Inc., Ann Arbor, MI (USA)**
Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)

**Stone and Webster Engineering Corp., Boston, MA (USA)**
Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)

**Strasbourg-1 Univ., 67 (France)**
Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)

**Stroud, Inc., Arvada, CO (USA)**
Weatherization assistance program: Final monitoring report for Arizona; California; the Navajo Nation; Nevada, 12:37067 (R;US)

**Structural and Earthquake Engineering Consultants, Inc., Arcadia, CA (USA)**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)

**Sussex Univ., Brighton (UK)**
Cosmic strings in an expanding spacetime, 12:38058 (R;US)

**Swedish Council for Building Research, Stockholm**
Conditions for solar district heating. Market analysis, 12:36680 (R;SE;In Swedish)
Dense in a right way. Energy aspects on the expansion of Gothenburg, 12:37021 (R;SE;In Swedish)
Heat pumps. Assesment of research and development projects for the three- year period from 1981/1982 to 1983/1984, 12:37020 (R;SE;In Swedish)
Occupant influence on energy consumption in single-family dwellings, 12:37019 (R;SE)
Sorption - compression heat pumps and heat transformers. Technology and economics - a feasibility study, 12:37022 (R;SE;In Swedish)

**Swedish Univ. of Agricultural Sciences, Uppsala. Dept. of Chemistry and Molecular Biology**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)

**Synergic Resources Corp., Bala-Cynwyd, PA (USA)**
Proceedings: 1986 Electric Utility Market Research symposium, 12:36995 (R;US)

**Syracuse Research Corp., NY (USA). Center for Chemical Hazard Assessment**
Information profiles on potential occupational hazards: benzoin, 12:37633 (R;US)
Summarization of recent literature pertaining to an occupational health standard for cadmium. Final report, 12:37991 (R;US)

**Syracuse Univ., NY (USA). Lab. of Solid State Science and Technology**
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)

**Systems Applications, Inc., San Rafael, CA (USA)**
Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain, 12:37659 (R;US)
Simulation of aerosol dynamics: a comparative review of mathematical models, 12:37643 (R;US)

**Systems Research Labs., Inc., Dayton, OH (USA)**
Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)

# T

**Taylor Woodrow Construction Ltd., Southall (UK)**
Noise prediction programme for wind turbines, 12:36738 (R;GB)
**Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA)**
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project, 12:37822 (R;US)
**Technadyne Engineering Consultants, Inc., Woods Hole, MA (USA)**
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
**Technical Univ. of Denmark, Lyngby. Inst. of Mathematical and Operations Research**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Elektrotechnik**
Optimized load distribution in supply systems with combined heat and power generation in consideration of the district heating network, 12:37146 (R;DE;In German)
**Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen**
Heating exchanger networks, an exergo-economic study, 12:37497 (R;DE;In German)
Studies on engine output control for internal combustion engines, 12:37165 (R;DE;In German)
**Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Meteorologie**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)
**Technische Univ. Berlin (Germany, F.R.). Fachbereich Konstruktion und Fertigung**
Applications of energy storage systems in lifting gears, 12:36936 (R;DE;In German)
**Technische Univ. Berlin (Germany, F.R.). Fachbereich Verfahrenstechnik**
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**Technische Univ. Braunschweig (Germany, F.R.). Fachbereich fuer Architektur**
Metal-glass facades with an integrated heating/cooling/ventilation system, 12:37076 (R;DE;In German)
**Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik**
Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation, 12:37164 (R;DE;In German)
**Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung**
Investigation of the structure of filter cakes from bore flushing. Investigation of temperature stability of bore flushing liquids based on water. Investigation of rock drilling processes with diamond cutters of peg shape, 12:36375 (R;DE;In German)
**Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet**
Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery, 12:36386 (R;DE;In German)
**Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik**
Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)
**Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen**
Numerical calculation of turbulent flow around a cubic element, 12:37498 (R;DE;In German)
**Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Angewandte Botanik**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)
**Teknekron Research, Inc., Berkeley, CA (USA)**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)
**Telic Co., Santa Monica, CA (USA)**
Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)
**Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering**
Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)
Signal validation in nuclear power plants: Progress report No. 2, 12:36813 (R;US)
**Tennessee Univ., Knoxville (USA). Dept. of Physics**
Effect of temperature on nondissociative electron attachment to molecules, 12:37388 (R;US)
Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/, 12:37294 (R;US)
The influence of N-ion irradiation on superconducting TiN, 12:37212 (R;US)
**Tennessee Valley Authority, Chattanooga (USA)**
Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)
**Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources**
Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir, 12:37846 (R;US)
Floods on East Fork Mulberry Creek and Price Branch in the vicinity of Lynchburg, Tennessee, 12:38040 (R;US)
**Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development**
Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir, 12:37846 (R;US)
Floods on East Fork Mulberry Creek and Price Branch in the vicinity of Lynchburg, Tennessee, 12:38040 (R;US)
**TENSA Services, Houston, TX (USA)**
Optimum heat pump placement in industrial processes: Executive summary, 12:37140 (R;US)
**Texas A and M Univ., College Station (USA)**
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
**Texas A and M Univ., College Station (USA). Dept. of Chemistry**
Properties of lanthanide oxides as supports for transition metal catalysts: Progress report for the period May 1, 1986 to April 30, 1987, 12:37333 (R;US)
**Texas A and M Univ., College Station (USA). Texas Transportation Inst.**
User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)
**Texas Southern Univ., Houston (USA). Dept. of Chemistry**
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Texas Tech Univ., Lubbock (USA)**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)
**Texas Tech Univ., Lubbock (USA). Textile Research Center**
Whisker reinforced structural ceramics: Progress in the VLS growth and use of long silicon carbide whiskers, 12:37300 (R;US)
**Texas Univ., Austin (USA)**
Coupling boundary integral and finite element formulations for nonlinear halfspace problems, 12:38412 (R;US)
**Texas Univ., Austin (USA). Center for Materials Science and Engineering**
High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)

**Texas Univ., Austin (USA). Center for Particle Theory**
Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories, 12:38164 (R;US)
Radiative B decays with four generations, 12:38163 (R;US)

**Texas Univ., Austin (USA). Dept. of Petroleum Engineering**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**Texas Univ., Austin (USA). Dept. of Physics**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**Texas Univ., Austin (USA). Inst. for Fusion Studies**
Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
Effects of ballooning instability on tokamak confinement, 12:38329 (R;US)
Low beta rigid mode stability criterion for an arbitrary Larmor radius plasma, 12:38334 (R;US)
Nonlinear dynamics of tearing modes in the reversed field pinch, 12:38332 (R;US)
Orbit extension method for finding unstable orbits, 12:38333 (R;US)
Plasma current sustained by fusion charged particles in a field reversed configuration, 12:38331 (R;US)

**Texas Univ., Dallas (USA)**
Retarding potential analyzer research. Semiannual report, 1 July-31 December 1986, 12:38087 (R;US)

**Texas Univ., El Paso (USA). Dept. of Civil Engineering**
Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)

**Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications**
Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986, 12:37473 (R;US)

**Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling, 12:37131 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 4.0, Single-cylinder engine tests, 12:37132 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 6.0 Determination of accurate heat release diagrams and mechanical efficiency, 12:37133 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)

**Tieraerztliche Hochschule Hannover (Germany, F.R.)**
Study investigating the impact of aircraft noise on physiological, endocrinological and ethological criteria with regard to pregnant sows, roaming free or kept in barns, 12:38014 (R;DE;In German)

**Tokyo Inst. of Tech. (Japan). Research Lab. of Nuclear Reactor**
New buildup factor data for point kernel calculations, 12:38291 (R;US)

**Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study**
Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984, 12:38232 (R;US)

**TRW Space and Technology Group, Redondo Beach, CA (USA)**
Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)

**Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy**
Simultaneous SMM flat-crystal spectrometer and Very Large Array observations of solar-active regions, 12:38056 (R;US)
Solar-active region physical parameters inferred from a thermal cyclotron line and soft-x-ray spectral lines, 12:38054 (R;US)
Very Large Array observations of the sun with related observations using the SMM (Solar Maximum Mission) satellite. Interim report, 1 January-31 December 1986, 12:38053 (R;US)
VLA (Very Large Array) observations of a solar-noise storm, 12:38055 (R;US)

# U

**UKAEA Atomic Energy Establishment, Winfrith**
Gamma tomography as an aid to experimental enhanced oil recovery, 12:36369 (R;GB)
Model surfactant studies 1: preliminary investigations of phase behaviour, 12:36368 (R;GB)
New extended black oil model for simulating gas cycling in retrograde condensate reservoirs, 12:36370 (R;GB)

**UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.**
Adaptive pitch control of a 25m wind turbine generator, 12:36740 (R;GB)
Algal biomass from farm waste. A pilot plant study, 12:36628 (R;GB)
Application of the WELC well cost estimating procedure, 12:36724 (R;GB)
Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis, 12:36739 (R;GB)
Cleethorpes geothermal exploration borehole. Drilling and testing programme. General report , 12:36722 (R;GB)
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)
First report on the visual impact of large wind turbines, 12:36737 (R;GB)
Geothermal aquifer studies. Heat pump study - preliminary review. Summary and recommendations, 12:36728 (R;GB)
Geothermal report. Low temperature radiator systems. Stage 1. Acquisition and collation of design data, 12:36727 (R;GB)
Heat loads in Great Grimsby. An analysis of the practicalities and economics of a hypothetical geothermal scheme, 12:36730 (R;GB)
Limits to process intensity in methane (biogas) generator systems, 12:36586 (R;GB)
Noise prediction programme for wind turbines, 12:36738 (R;GB)
Preliminary survey of tidal energy of U.K. estuaries, 12:36732 (R;GB)
Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes, 12:36729 (R;GB)
Report on anaerobic digestion of dairy cattle wastes to October 1981, 12:36585 (R;GB)
Survey of existing methods of biogas scrubbing and utilisation, 12:36587 (R;GB)
Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK , 12:36733 (R;GB)
WELC (version 1): well cost estimating, 12:36723 (R;GB)

**UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.**
The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)

**Umweltbundesamt, Berlin (Germany, F.R.)**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)

**UNC Geotech, Grand Junction, CO (USA)**
Validation of the abbreviated Radon Progeny Integrating Sampling Unit (RPISU) method for Mesa County, Colorado, 12:37820 (R;US)

**UNC Nuclear Industries, Inc., Richland, WA (USA)**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
UNC environmental surveillance report for the 100 areas: FY 1985, 12:36816 (R;US)
UNC environmental surveillance report for the 100 areas: FY 1986, 12:36817 (R;US)

**United Industries Corp., Bellevue, WA (USA)**
Energy conservation in the food industry: Follow-up report, 12:37130 (R;US)

**United Technologies Research Center, East Hartford, CT (USA)**
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer. Final report, 12:37496 (R;US)

**Universities Space Research Association, Boulder, CO (USA)**
Prediction of recirculation zones in isothermal coaxial jet flows relevant to combustors, 12:37494 (R;US)

**University of Southern California, Los Angeles (USA)**
Chemical form and leachability of inorganic trace elements in coal ash: Final report, 12:36328 (R;US)
Microbial screening test for lignite degradation: Quarterly progress report No. 10 for the period April-June 1987, 12:36311 (R;US)
**University of South Florida, Tampa (USA)**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
**URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**USDOE Albuquerque Operations Office, NM**
Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado: Volume 1, Text, 12:36548 (R;US)
**USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office**
Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming, 12:36547 (R;US)
Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico, 12:36552 (R;US)
**USDOE Assistant Secretary for Defense Programs, Washington, DC**
Defense Waste Management Plan for buried transuranic-contaminated waste, transuranic-contaminated soil, and difficult-to-certify transuranic waste, 12:36506 (R;US)
Department of Energy Emergency Management Functional Requirements Study, 12:36558 (R;US)
**USDOE Assistant Secretary for Fossil Energy, Washington, DC**
America's clean coal commitment, 12:36235 (R;US)
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
**USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Coal Utilization and Extraction**
Status of commercial fuel cell powerplant system development, 12:37012 (R;US)
**USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves**
Strategic Petroleum Reserve: Quarterly report, 12:36427 (R;US)
**USDOE Assistant Secretary for Management and Administration, Washington, DC. Chief Historian**
A history of the United States Atomic Energy Commission, 1952-1960: Volume 3, 12:37593 (R;US)
**USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)
**USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Small and Disadvantaged Business Utilization**
Doing business with the Department of Energy, 12:38394 (R;US)
**USDOE Bartlesville Project Office, OK**
Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)
**USDOE Bonneville Power Administration, Portland, OR**
1986 variable industrial power rate: Executive summary of Administrator's Record of Decision, 12:36994 (R;US)
**USDOE Chicago Operations Office, Argonne, IL. Crystalline Repository Project Office**
Area Recommendation Report for the Crystalline Repository Project: Volume 1, Draft, 12:36504 (R;US)
Area Recommendation Report for the Crystalline Repository Project: Volume 2, Plates: Draft, 12:36505 (R;US)
**USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels**
Documentation of the resource allocation and mine costing (RAMC) model: Methodology description, 12:36984 (R;US)
**USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
Monthly energy review, March 1987, 12:36977 (R;US)
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas**
Petroleum marketing monthly, April 1987, 12:36417 (R;US)
The petroleum resources of China, 12:36381 (R;US)
**USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board**
Review of the National Research Council report: Physics through the 1990's, 12:36972 (R;US)
**USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences**
Office of Basic Energy Sciences: 1986 summary report, 12:38393 (R;US)
**USDOE Pittsburgh Energy Technology Center, PA**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)
An automated microscopic method for the determination of pyrite size distributions in crushed coal, 12:36298 (R;US)
An experimental study of heat of immersion of coal, 12:36292 (R;US)
Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
FY 86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center, 12:36231 (R;US)
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
Properties of CuO sorbents related to $SO_2$ reactivity, 12:36760 (R;US)
Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
Surface chemical problems in coal flotation, 12:36234 (R;US)
**USDOE San Francisco Operations Office, Oakland, CA**
Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes, 12:36377 (R;US)
**USDOE, Washington, DC**
The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
**Utah State Univ., Bedford, MA (USA). Stewart Radiance Lab.**
Medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide at 800k, 12:38018 (R;US)
**Utah State Univ., Logan (USA). Center for Atmospheric and Space Sciences**
Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986, 12:38086 (R;US)
**Utah State Univ., Logan (USA). Center for Space Engineering**
Atmospheric radiance profile codes. Technical report, 12:38085 (R;US)
Studies of infrared aurorae. Technical report, 12:38041 (R;US)
**Utah Univ., Salt Lake City (USA)**
Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987, 12:36237 (R;US)

## V

**Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)

**Velan, Inc., Montreal, Quebec (Canada)**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
**Versar, Inc., Springfield, VA (USA)**
Superfund treatment technologies: a vendor inventory, 12:37814 (R;US)
**VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.)**
Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**
Adaptive transmission system relaying, 12:36768 (R;US)
Mechanical and thermal characterization of unidirectional aramid/epoxy. Final report, November 1985-December 1986, 12:37329 (R;US)
**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**Virginia Polytechnic Inst., Blacksburg (USA)**
Impact of adaptive protection on power system control, 12:36769 (R;US)
Some applications of phasor measurements to adaptive protection, 12:37511 (R;US)
**Virginia Univ., Charlottesville (USA)**
Collisional dynamics of perturbed particle disks in the solar system. Annual technical progress report, 12:38061 (R;US)
**Virginia Univ., Charlottesville (USA). Dept. of Civil Engineering**
Innovative financing for transportation: practical solutions and experiences. Final report, 12:37101 (R;US)
**Virginia Univ., Charlottesville (USA). Dept. of Electrical Engineering**
SIS (superconductor-insulator-superconductor) mixer research. Final report, 15 November 1985-14 November 1986, 12:37452 (R;US)
**Volkswagen of America, Inc., Ann Arbor, MI**
Application for certification 1987 model year light-duty vehicles - Volkswagen, 12:37180 (R;US)

## W

**Warsaw Univ. (Poland)**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
**Washington Univ., Seattle (USA)**
Genetics and biochemistry of the Rhizobium meliloti acidic extracellular heteropolysaccharide and its role in nodulation: Annual report for the period 1 June 1986-31 May 1987, 12:36626 (R;US)
**Washington Univ., Seattle (USA). Dept. of Atmospheric Sciences**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**Washington Univ., Seattle (USA). Dept. of Civil Engineering**
Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report, 12:36610 (R;US)
**Washington Univ., Seattle (USA). Dept. of Physics**
Influence of six-quark bags on electron scattering, 12:38268 (R;US)
The EMC effect and related issues, 12:38269 (R;US)
X-ray spectroscopy of solids under pressure: Technical progress report, July 1984-April 1987, 12:37335 (R;US)
**Washington Univ., Seattle (USA). Nuclear Physics Lab.**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**Washington Univ., St. Louis, MO (USA)**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**Washington Univ., St. Louis, MO (USA). McDonnell Center for the Space Sciences**
The early solar system abundance of $^{244}$Pu as inferred from the St. Severin chondrite, 12:38070 (R;US)
**Waterloo Univ., Ontario (Canada)**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Western Research Inst., Laramie, WY (USA)**
Combined gas chromatography/mass spectrometric evaluation of selected isothermally produced shale oils, 12:36475 (R;US)
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
Reverse combustion in asphalt ridge tar sand, 12:36468 (R;US)
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**
Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O/sub\ x/$, 12:37288 (R;US)
**West Valley Nuclear Services Co., Inc., West Valley, NY (USA)**
Decontamination of the Scrap Removal Room at the West Valley Demonstration Project, 12:36508 (R;US)
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)
**West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering**
Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986, 12:36354 (R;US)
**Wisconsin Univ., Madison (USA)**
Physics simulations at high energy, 12:38207 (B;SG)
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**Wisconsin Univ., Madison (USA). Solar Energy Lab.**
A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing, 12:36682 (R;US)
Analysis of the seasonal performance of hybrid desiccant cooling systems, 12:36681 (R;US)
**Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft**
Energy conservation between environmental policy and consumer policy. Experience from eight countries, 12:37070 (R;DE;In German)
Forestry and forest industries in Liberia. An example in ecological destabilization, 12:37897 (R;DE)
Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
Publications on environmental policy in Japan, 12:36961 (R;DE;In German)
**World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)**
Sunspot numbers: 1610-1985 based on The Sunspot-Activity in the Years 1610-1960', 12:38067 (R;US)
**Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering**
Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
Use of basic nitrogen to chemically clean coal: Quarterly report No. 3 for the period March 16, 1987 to June 15, 1987, 12:36238 (R;US)
**Wyoming Univ., Laramie (USA). Office of Univ. Research**
Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)

## Y

**Y-ARD Ltd., Glasgow (UK)**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)

## Z

**Zaininger Engineering Co., San Jose, CA (USA)**
Electrical behavior of wind power stations: Final report, 12:36646 (R;US)

**Zeopower Co., Natick, MA (USA)**
Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986, 12:37079 (R;US)

# PERSONAL AUTHOR INDEX

Authors' surnames are indexed in the form appearing in the abstracted publication; given names are reduced to initials. Each author entry gives the publication title and the citation number. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German; are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes. For publications with multiple authors, an entry is provided for each author. Entries for the second and succeeding authors give references to the first author.

Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

## A


**Abbin, J.P.,** *See* Lukens, L.L., 12:36657

**Abdelmalek, S.H.,** Energy optimisaton at the Whyalla reheating furnace, 12:37128 (RA;SE)

**Abderrahmani Ghorfi M.,** Development possibilities of solid mineral fuels in the energy balance of Morocco, 12:36978 (R;FR;In French)

**Abdulrashid, N.,** Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli, 12:37870 (J;US)

**Abe, K.,** Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)

**Abe, M.,** Numerical analysis of heat transfer in continuous reheating furnace, 12:37107 (RA;SE)

**Abe, Y.,** *See* Akimoto, H., 12:36887
*See* Iguchi, T., 12:36859
*See* Iwamura, T., 12:36860
*See* Murao, Y., 12:36861

**Abenante, V.,** *See* Halbert, M.L., 12:38251

**Abolfadl, M.,** *See* Theofanous, T.G., 12:36914

**Acharya, A.,** Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)

**Achenbach, E.,** Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)

**Ackerhalt, J.R.,** The group velocity of short optical pulses, 12:38318 (BA;US)

**Ackerman, J.L.,** *See* Ellingson, W.A., 12:37284

**Acrivos, A.,** *See* Chang, E.Y., 12:37503

**Adachi, H.,** *See* Iguchi, T., 12:36859
*See* Iwamura, T., 12:36860
*See* Murao, Y., 12:36861

**Adam, M.E.,** Improved stopping, door, and overcast construction for oil-shale mines. Open File report, June 1984-September 1986, 12:36465 (R;US)

**Adams, F.C.,** *See* Freese, K., 12:38071

**Adams, M.B.,** Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)

**Adams, R.E.,** Influence of moisture on the behavior of aerosols, 12:36898 (RA;US)

**Addabbo, C.,** PWR recovery procedures investigated in the LOBI-MOD2 test facility, 12:36842 (RA;US)

**Adelberger, E.G.,** Nuclear probes of fundamental symmetries, 12:38283 (BA;DE)

**Aderholz, M.,** Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)

**Adewumi, M.A.,** Pseudo-two-dimensional steady state two-phase flow model for gas-solids vertical pneumatic conveying systems, 12:37504 (B;US)

**Adler, L.,** *See* Nagy, P.B., 12:37263, 12:37365
*See* Rokhlin, S.I., 12:37362

**Aeron, S.M.,** *See* Ramachandran, N., 12:37108

**Agapito, J.F.T.,** *See* Adam, M.E., 12:36465

**Agouridis, D.C.,** Thermal noise in linear passive multiports, 12:37512 (R;US)

**Agrawal, R.K.,** *See* Helt, J.E., 12:37154, 12:37855

**Aharoni, H.,** *See* Emery, K.A., 12:36643

**Ahlen, S.P.,** *See* Avignone, F.T. III, 12:38248

**Ahmad, J.,** *See* Wilkowski, G.M., 12:36804

**Ahrens, L.A.,** Comparison of narrow-band and wide-band neutrino beams in the search for $\nu$/sub $\mu$/$\rightarrow\nu$/sub e/ oscillations, 12:38150 (J;US)
*See* Abe, K., 12:38115

**Aiyar, G.S.,** Design of saltstone vaults, 12:36512 (R;US)

**Akau, R.L.,** *See* Moya, J.L., 12:37460

**Akbari, H.,** Undoing uncomfortable summer heat islands can save gigawatts of peak power, 12:37029 (RA;US)

**Akers, D.W.,** TMI-2 lower vessel debris examinations, 12:36894 (RA;US)

**Akimoto, H.,** Status of J-TRAC code development, 12:36887 (RA;US)
*See* Iguchi, T., 12:36858
*See* Murao, Y., 12:36861

**Akimoto, J.,** *See* Iguchi, T., 12:36859

**Akin, M.R.,** Optimisation of a membrane cell cascade for chlorine alkali electrolysis under the aspect of energy consumption, 12:37405 (R;DE;In German)

**Aksan, S.N.,** *See* Analytis, G.Th., 12:36885

**Alber, G.,** Master-equation approach to collisionally induced absorption and emission, 12:38093 (R;US)

**Albrecht, W.N.,** *See* Stephenson, R.L., 12:37626

**Alexander, V.,** Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)

**Alexander J.,** Study of QED radiative corrections at the Z, 12:38168 (RA;US)

**Alfert, F.,** Safety characteristics of polynary fuel/air mixtures and self-disintegrating substances, 12:37443 (R;DE;In German)

**Alhassid, Y.,** Algebraic approach to scattering and the Euclidean connection, 12:38212 (BA;US)

**Allan, J.W.,** *See* Burton, T.M., 12:37843

**Allan, R.R.,** *See* Boshier, J.F., 12:36952

**Allebach, J.P.,** *See* Seldowitz, M.A., 12:38313

**Allen, G.C. Jr.,** *See* Freedman, J.M., 12:37465

**Allen, J.W.,** *See* Cole, R.L., 12:37527

**Allen, L.P.,** Successful molecular beam epitaxy growth and characterization of (110) GaAs/GaAs and (110) AlGaAs/GaAs, 12:37339 (R;US)

**Allen, M.D.,** *See* Cheng, Y.S., 12:37613

**Allen, S.J.,** United States Coast Guard portable salvage computer. Final report, 12:36956 (R;US)

**Allison, C.M.,** SCDAP/RELAP5 update and applications, 12:36908 (RA;US)

**Allshouse, G.O.,** *See* Cook, D.L., 12:38390

**Almaguer, D.,** Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
*See* Boiano, J.M., 12:37697, 12:37698, 12:37701

**Almenas, K.,** Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system, 12:36846 (RA;US)

**Alonso, A.,** Validation of TRAC-PD2 against experiment LP-02-6 of the OECD-LOFT series, 12:36878 (RA;US)

**Alsmiller, F.S.,** *See* Alsmiller, R.G. Jr., 12:37544

**Alsmiller, R.G. Jr.,** Calculated fraction of an incident current pulse that will be accelerated by an electron linear accelerator and comparisons with experimental data, 12:37544 (J;NL)

**Altpeter, L.L. Jr.,** *See* Gaynor, A.J., 12:36459

**Alzheimer, J.M.,** Pipe-to-pipe impact program, 12:36778 (R;US)
**Amako, K.,** *See* Abe, K., 12:38115
**Amarasooriya, W.H.,** *See* Theofanous, T.G., 12:36914
**Amato, A.,** *See* Fisher, R.A., 12:37227
**Ambrose, K.R.,** *See* Knapp, F.F. Jr., 12:37878
**Ambrose, R.B.,** *See* Barnwell, T.O., 12:37839
**Ames, J.,** *See* Mitchell, C.E., 12:37978
**Amundsen, E.S.,** Safety and optimal prevention of platform accidents, 12:36413 (R;NO)
**Analytis, G.Th.,** Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
**Anand, D.K.,** Dynamic performance of absorption systems for control simulation, 12:36700 (BA;US)
*See* Helferty, J.J., 12:36717
**and others,** *See* Ahrens, L.A., 12:38150
*See* Rapaport, J., 12:38241
*See* Sullivan, M.W., 12:38151
**Andersen, J.G.M.,** TRAC development at General Electric, 12:36876 (RA;US)
**Anderson, D.A.,** *See* Chiappetta, R.F., 12:36346
**Anderson, G.L.,** Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants: Final report for the period October 1982-January 1985, 12:37011 (R;US)
**Anderson, J.,** Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
*See* Teotia, A.P.S., 12:37018, 12:37024
**Anderson, J.M.,** Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report, 12:36754 (R;US)
**Anderson, J.V.,** *See* Chuah, Y.K., 12:36669
**Anderson, K.E.,** Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
**Anderson, L.L.,** *See* Howell, R.W., 12:36439
**Anderson, M.S.,** Dynamic etching tests aid fracture acidizing treatment design, 12:36390 (BA;US)
**Anderson, P.,** *See* Doyle, S.M., 12:38083
**Anderson, R.J.,** Deposition effects in pressurized combustion of coal-derived fuels, 12:36357 (RA;US)
**Anderson, R.L.,** *See* Hashemian, H.M., 12:36774
**Andersson, H.,** Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Ando, J.,** FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
**Andraka, C.E.,** *See* Lukens, L.L., 12:36657
**Andreani, M.,** *See* Analytis, G.Th., 12:36885
**Andreani, R.,** Contributions to the 14th symposium on fusion technology, 12:38379 (R;IT)
**Ankenbrandt, C.,** *See* Diebold, R., 12:37536
**Anlage, S.M.,** *See* Woodruff, D.M., 12:38303
**Antcliff, R.R.,** Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)
**Antonsen T.M. Jr.,** *See* Finn, J.M., 12:38359
**Antunez, E.,** *See* Falade, G.K., 12:36383
**Aoki, H.,** *See* Crabtree, G.W., 12:37205
**Apol, A.,** Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)
**Apol, A.G.,** Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington, 12:37629 (R;US)
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)
**Appelhans, A.D.,** Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)
**Appert, Q.D.,** *See* Knapp, C.E., 12:37484
**Applegate, D.S.,** *See* Goretta, K.C., 12:37306
**Aprahamian, A.,** *See* Meyer, R.A., 12:38256
**Aragon, J.,** *See* Marshall, A.C., 12:36789
**Araj, K.,** *See* Slovik, G., 12:36784
**Araj, K.J.,** *See* Benenati, R., 12:36781
*See* Lazareth, O.W., 12:36779
**Arastoopour, H.,** *See* Adewumi, M.A., 12:37504
**Arbaugh, M.J.,** *See* Peterson, D.L., 12:37946
**Archer, J.A.,** *See* Kuhlmeier, P.D., 12:36518
**Archer, J.S.,** *See* Norman, R., 12:36433
**Argo, B.E.,** *See* Schuresko, D.D., 12:38372
**Arko, A.J.,** Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**Armstrong, D.R.,** *See* Cho, D.H., 12:37390
**Armstrong, D.W.,** *See* Han, S.M., 12:37358
**Arnaud, J.,** Procedures for reduction of Fe XII 10747 A coronal emission-line polarization observations. Technical note, 12:38064 (R;US)
**Arnold, M.,** *See* Freedman, S.J., 12:38153
**Arnts, R.R.,** Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)
**Aronson, S.H.,** *See* Abe, K., 12:38115
*See* Ahrens, L.A., 12:38150
**Arpiainen, V.,** Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
**Arrighi, E.,** *See* Soresina, R., 12:37127
**Arulmoli, K.,** Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff, 12:36538 (R;US)
**Arunasalam, V.,** *See* Hill, K.W., 12:38382
**Arunasalan, V.,** *See* Goldston, R.J., 12:38351
**Arvizu, D.E.,** Progress in photovoltaic concentrator research, 12:36644 (BA;US)
**Arwood, P.C.,** *See* Wright, A.L., 12:36900
**Asher, R.C.,** The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)
**Ashley, C.S.,** Sol-gel AR films for solar applications, 12:37369 (BA;US)
**Ashurst, W.T.,** Alignment of vorticity and scalar gradient with strain rate in simulated Navier—Stokes turbulence, 12:38106 (J;US)
**Ashwil, T.D.,** Structural design and fabrication of the Sandia 34-meter vertical axis wind turbine, 12:36746 (BA;US)
**Assink, R.A.,** *See* Kay, B.D., 12:37313
*See* Kay, Bruce D., 12:37407
**Ast, D.G.,** *See* Sullivan, T., 12:36635
**Atlas, H.,** A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Atmaram, G.H.,** Operational experience with grid-connected photovoltaic systems, 12:36651 (BA;US)
**Attipoe, J.,** Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**Attwood, D.,** Tunable coherent x-rays, 12:37559 (J;US)
**Atwater, H.F.,** *See* Coop, K.L., 12:36562
**Ausman, G.A.,** Field dependence of geminate recombination in a dielectric medium. Final report, October 1974-September 1975, 12:37280 (R;US)
**Austin, L.G.,** Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Austin, P.N.,** *See* Minarick, J.W., 12:36921, 12:36922
**Avella, R.,** Environmental effects due to the use of conventional and innovating fuels for autotraction, 12:37607 (R;IT;In Italian)
**Avery, J.G.,** System selection and life testing results of drain down and glycol closed loop active systems, 12:36660 (BA;US)
**Avignone, F.T. III,** Ultralow background searches for $\beta\beta$-decay, cold dark matter and solar axions, 12:38248 (BA;DE)
*See* Brodzinski, R.L., 12:37569
**Avignone III, F.T.,** *See* Toth, K.S., 12:38253
**Ayres, D.S.,** Electrodeless drift chambers with 50-CM drift distance, 12:37575 (BA;US)
**Azab, K.A.,** Modeling the viscous wall region, 12:38107 (J;US)

## B

**Babelot, J.F.,** *See* Lindner, R., 12:37183
**Baber, D.N.,** Possible calorimetric effects at Mercury due to solar wind-magnetosphere interactions, 12:38072 (J;US)
**Bacconnet, E.,** Vignola project, 12:36654 (R;FR;In French)
**Bacelar, J.C.,** *See* Voigt, M.J.A. de, 12:38258
**Bachmann, P.,** What does the customer expect from inventories of endangered forests, 12:37895 (RA;DE;In German)
**Bachta, R.,** *See* Parkinson, W.J., 12:36472
**Back, H.G.,** Uptake and distribution of heavy metals in annelidae, with

particular regard to limnic tubificides (oligochaeta), 12:37987 (R;DE;In German)
**Backlund, H.,** Induction heating in rolling mills - new ideas and applications, 12:37122 (RA;SE)
**Bader, S.D.,** *See* Moog, E.R., 12:37216
**Baes, C.F. III,** *See* Braeker, O.U., 12:37796
**Baetke, F.,** Numerical calculation of turbulent flow around a cubic element, 12:37498 (R;DE;In German)
**Baik, S.,** Preparation of Al/sub 2/O/sub 3/-ZrO/sub 2/ composites by adjustment of surface chemical behavior, 12:37308 (BA;US)
**Bailey, J.,** *See* Cook, D.L., 12:38390
**Bailey, W.J.,** Rod consolidation of RG and E's [Rochester Gas and Electric Corporation] spent PWR [pressurized water reactor] fuel, 12:36493 (R;US)
**Bainbridge, B.L.,** Heat transfer to large objects in large pool fires, 12:37464 (R;US)
**Baity, F.W.,** *See* Hoffman, D.J., 12:38373
*See* Swain, D.W., 12:38374
**Bajura, R.A.,** Gasification island concept systems, 12:36257 (RA;US)
**Baker, E.G.,** Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)
**Baker, E.T.,** *See* Tennant, D.A., 12:37842
**Baker, N.J.,** Limits on likesign dilepton production in $\nu$/sub $\mu$/ interactions, 12:38243 (BA;US)
**Baker, W.E.,** A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
**Bakke, T.,** Long term effects of oil on marine benthic communities in enclosures, 12:36420 (R;NO)
**Balanda, A.,** *See* Voigt, M.J.A. de, 12:38258
**Baldo, P.M.,** *See* King, W.E., 12:37203
**Baldwin, R.M.,** *See* Miller, R.L., 12:36272
**Balfe, C.A.,** Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/ Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**Ball, J.R.,** Arms control and treaty verification technology: Contributions from the nonweapons laboratories, 12:37194 (R;US)
**Baltay, C.,** *See* Baker, N.J., 12:38243
**Bampton, M.C.C.,** *See* Alzheimer, J.M., 12:36778
**Bander, T.J.,** *See* Strenge, D.L., 12:37931
**Bangerter, R.O.,** Important atomic physics issues for ion beam fusion, 12:38383 (R;US)
**Banks, J.C.G.,** Fire and stand histories in subalpine forests on the Thredbo ski slopes, Koscuisko, National Park, NSW, Australia, 12:37747 (RA;US)
**Banks, T.,** New stable charged particles, 12:38181 (RA;US)
**Bapat, P.M.,** *See* Savastano, C.A., 12:37424
**Barber, G.C.,** *See* Schuresko, D.D., 12:38372
**Barbiellini, G.,** Results on theta/sub w/ from the CERN high-energy neutrino experiments or: why theta/sub w/? How theta/sub w/?, 12:38133 (RA;US)
Search for flavor-changing neutral currents at the $Z^0$, 12:38165 (RA;US)
**Bard, F.E.,** *See* Weber, E.T., 12:36820
**Barger, V.,** Physics simulations at high energy, 12:38207 (B;SG)
**Barker, L.M.,** *See* Chhabildas, L.C., 12:37241
**Barklow, T.,** Supersymmetric particle searches, 12:38177 (RA;US)
**Barlow, R.,** Results from PETRA, 12:38135 (RA;US)
**Barnard, J.C.,** Improving the performance of mass-consistent numerical models using optimization techniques, 12:36736 (J;US)
**Barnard, J.E.,** Survey to assess the effects of atmospheric deposition on forest vegetation, 12:37783 (RA;DE)
**Barnard, W.F.,** *See* Wright, R.S., 12:37637
**Barnes, C.R.,** *See* Wilkowski, G.M., 12:36804
**Barnes, D.C.,** *See* Schwarzmeier, J.L., 12:38363
**Barnes, G.A.,** *See* Siemon, R.E., 12:38341
**Barnett, K.W.,** *See* Dykes, R.M., 12:37158
**Barnhisel, R.I.,** Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)
**Barnwell, T.O.,** Water-quality-modeling software available from US EPA (Environmental Protection Agency), 12:37839 (R;US)
**Barowy, W.M.,** Medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide at 800k, 12:38018 (R;US)
**Barr, E.B.,** *See* Mauderly, J.L., 12:36476
*See* Wolff, R.K., 12:37967
**Barrett, J.P.,** Monitoring the growth and health of white pine in New Hampshire, 12:37784 (RA;DE)
**Barrett, L.H.,** Developing a national system for transporting high-level nuclear waste, 12:36495 (BA;US)
**Barron, T.S.,** Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
**Barrows, L.J.,** *See* Kerfoot, H.B., 12:37810
**Bartel, W.,** Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Bartell, S.M.,** Temporal variation in regulation of production in a pelagic food web model, 12:37833 (R;US)
*See* Boston, H.L., 12:37838
**Bartelt, J.,** *See* Banks, T., 12:38181
**Bartsch, R.A.,** Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)
**Basinska-Lewin, E.,** *See* Doyle, S.M., 12:38083
**Basu, D.K.,** *See* Reisman, D.J., 12:37990
**Batchelor, D.B.,** Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
**Bateman, V.I.,** Characterization of accelerometer mountings in shock environments, 12:37579 (R;US)
**Bates, J.M.,** *See* Drost, M.K., 12:36939
**Bathen, K.H.,** Laboratory tests of cleaning techniques for immiscible solar ponds, 12:36714 (BA;US)
**Batigun, C.M.,** Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report], 12:38292 (R;US)
**Batistoni, P.,** Calculations of total fusion power and spatial distribution of emissivity for a D-T thermal plasma. Part I, 12:38335 (R;IT)
**Bauer, R.A.,** *See* Kempton, J.P., 12:37562
**Bauer, R.W.,** Neutron capture cross sections for $^{86}$Sr and $^{87}$Sr at stellar temperatures, 12:38247 (BA;DE)
**Baughcum, S.L.,** *See* Oldenborg, R.C., 12:36302
**Baumann, W.,** *See* Wolf, L., 12:36888
**Baumgardt, B.,** Trace element analyses in order to determine heavy metal concentrations in lung tissues. A contribution to an objective assessment of occupational hazards, 12:37985 (R;DE;In German)
**Baxter, D.J.,** Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)
**Baxter, W.D.,** Alternative energy sources guidebook. Final report, 12:37003 (R;US)
**Baylon, D.,** *See* DeLaHunt, M.J., 12:37034
**Bazan, J.M.,** *See* Lindner, M., 12:38257
**Beavers, W.M.,** *See* Reeves, S.R., 12:36444
**Becher, G.,** Mathematical and statistical evaluations of needle analyses, 12:37941 (RA;DE;In German)
**Becher, P.F.,** *See* Baik, S., 12:37308
**Beck, E.M.,** *See* Voigt, M.J.A. de, 12:38258
**Beckel, C.L.,** *See* Emin, D., 12:37304
**Becker, D.,** *See* Evens, A., 12:37037
**Becker, J.A.,** *See* Bauer, R.W., 12:38247
**Becker, L.,** *See* Bartel, W., 12:38117
**Beckman, W.A.,** *See* Kummer, J.P., 12:36671
**Beckner, W.D.,** Revision of the ECCS rule, 12:36837 (RA;US)
**Beene, J.R.,** *See* Bertrand, F.E., 12:38263
*See* Halbert, M.L., 12:38251
**Beer, J.M.,** *See* Rini, M.J., 12:36361
**Begin, C.,** Dating landslides in Hudson Bay area, Quebec, 12:38023 (RA;US)
**Begovic, M.M.,** *See* Thorp, J.S., 12:37511
**Behr, J.A.,** *See* Kicinska-Habior, M., 12:38244
**Behrend, H.J.,** Excited lepton search, 12:38116 (R;DE)
**Behrens, W.J.,** Shelf Edge Exchange Processes: Phase 1 (SEEP-1), Hydrography report, July 1983-October 1984, 12:38049 (R;US)
**Beier, E.W.,** *See* Abe, K., 12:38115
**Beiersdorfer, P.,** *See* Hill, K.W., 12:38346
**Beiny, D.H.,** Solubilities of higher normal alkanes in m-xylene, 12:37417 (J;US)
**Bekefi, G.,** *See* Fajans, J., 12:37472
**Belanger, P.L.,** Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)
**Bell, J.B.,** Adaptive methods for high Mach number reacting flow, 12:37502 (R;US)
*See* Szymczak, W.G., 12:38104
**Bell, K.J.,** *See* Panchal, C.B., 12:36678
**Bell, M.G.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Bell, R.J.,** Recommended practices for operating and maintaining steam surface condensers: Final report, 12:36752 (R;US)
**Bellissent, R.,** *See* Menelle, A., 12:37330

**Belshe, R.,** *See* Shen, L., 12:37057
**Bender, D.A.,** *See* Summers, M.A., 12:37487
**Bender, S.C.,** *See* Knapp, C.E., 12:37484
**Benedick, W.B.,** *See* Cummings, J.C., 12:36579
**Benenati, R.,** Thermal-hydraulic considerations for particle bed reactors, 12:36781 (R;US)
*See* Slovik, G., 12:36784
**Bengtsson, G.,** Approach and methodology for monitoring of the health of forests in Sweden, 12:37785 (RA;DE)
**Bennett, C.L.,** Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**Bennett, D.,** *See* Lee, S.A., 12:37630
**Bennett, G.W.,** An introduction to the physics and instrumentation of positron emission tomography, 12:37874 (R;US)
**Bennett, J.P.,** *See* Treshow, M., 12:37945
**Bensarsa, F.,** Selective absorption of hydrogen sulfide in carbon dioxide by methyldiethanolamine. Study of a new type of vertical ascending cocurrent flow contactor, 12:37375 (R;FR;In French)
**Benson, D.K.,** *See* Potter, T.F., 12:37054
**Benson, J.M.,** *See* Pickrell, J.A., 12:37971
**Benson, S.E.,** *See* Thomas, G.H., 12:37272
**Bentley, C.L. Jr.,** Empirical model for near-to far-field wakes behind a smooth cylindrical pole tower, 12:36748 (BA;US)
**Bentley, H.W.,** *See* Norris, A.E., 12:36520
**Bentley, J.,** Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
*See* More, K.L., 12:37289
*See* Nixon, R.D., 12:37281
**Berdahl, C.M.,** *See* Suitor, J.W., 12:36254, 12:36256
**Berdermann, E.,** *See* Tsertos, H., 12:38095
**Beretta, A.,** Delphos project - Wind actions on a parallel-rope tensio-structure for photovoltaic systems, 12:36645 (R;IT;In Italian)
**Bergan, N.E.,** An external molten salt solar central receiver test, 12:36665 (BA;US)
*See* Boehm, R., 12:36663
**Berger, A.E.,** *See* Szymczak, W.G., 12:38104
**Berger, E.L.,** Massive lepton pair production - the Drell-Yan process - with nuclear targets, 12:38282 (BA;DE)
Semi-inclusive inelastic electron scattering from nuclei, 12:38265 (R;US)
**Berger, M.H.,** Computer-extended series for a source/sink driven gas centrifuge, 12:36483 (J;GB)
Finite element analysis of flow in a gas-filled rotating annulus, 12:36482 (J;GB)
**Bergeron, K.D.,** Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
**Berggreen Petersen, M.,** Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)
**Berglund, K.A.,** *See* Hartel, R.W., 12:37310
*See* Payne, M.J., 12:37426
**Bergman, P.D.,** *See* Wen, W.W., 12:36230
**Berk, H.L.,** Low beta rigid mode stability criterion for an arbitrary Larmor radius plasma, 12:38334 (R;US)
Plasma current sustained by fusion charged particles in a field reversed configuration, 12:38331 (R;US)
**Berkowitz, C.M.,** *See* Hales, J.M., 12:37704
**Berkshire, L.H.,** *See* Bajura, R.A., 12:36257
**Berman, B.L.,** *See* Moran, M.J., 12:37509
**Berman, M.,** Recent results in hydrogen research, 12:36915 (RA;US)
*See* Marshall, B.W. Jr., 12:36913
**Berna, G.A.,** *See* Allison, C.M., 12:36908
**Bernard, M.J. III,** Institutional Conservation Program evaluation project: Results of higher education survey pretest, 12:37016 (R;US)
**Berry, F.O.,** *See* Anderson, G.L., 12:37011
**Berry, G.F.,** *See* Lyczkowski, R.W., 12:36352
**Berry, L.,** Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota, 12:37078 (R;US)
**Bers, A.,** *See* Fuchs, V., 12:38328
**Bertrand, F.E.,** Photon decay of giant resonances, 12:38263 (BA;DE)
**Berven, B.A.,** A method to automate the radiological survey process, 12:37819 (R;US)
**Besen, M.,** *See* Greenwald, M., 12:38326
**Besmann, T.M.,** *See* Lowden, R.A., 12:37301
**Bessenrodt-Weberpals, M.,** *See* Stefanov, B., 12:38354
**Betten, P.R.,** *See* Chang, L.K., 12:36933
**Beyer, C.E.,** *See* Levy, I.S., 12:36494
**Beynon, T.G.R.,** Two sensor measurement of slab temperature in reheat furnace: results of controlled trials on gas and oil fuels, 12:37105 (RA;SE)
**Bhattacharya, S.K.,** Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report, 12:36588 (R;US)
**Bhore, N.,** *See* Bischoff, K.B., 12:36597
**Biallas, G.,** The CEBAF [Continuous Electron Beam Accelerator Facility] cavity cryostat, 12:37548 (R;US)
*See* Brindza, P., 12:37549
**Bianchini, M.,** *See* Bown, J.R., 12:36425
**Biau, G.,** New slab reheating turnace of Sollac, 12:37116 (RA;SE)
**Bice, D.E.,** *See* Finch, G.L., 12:37965
*See* Gillett, N.A., 12:37884
*See* Haley, P.J., 12:37869
*See* Harmsen, A.G., 12:37973
*See* Mauderly, J.L., 12:36476
**Bickel, T.C.,** Application of laboratory results to the design of a high yield VMIS oil shale retort, 12:36471 (B;US)
*See* Gorham-Bergeron, E., 12:36466
**Biefeld, R.M.,** The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices, 12:37349 (R;US)
**Bielecki, A.,** Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)
**Bienkowski, P.R.,** Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
**Biggs, C.A.,** *See* Buchanan, A.C. III, 12:36296
**Bigi, I.I.,** Indirect searches for ultra-heavy quarks in rare decays, 12:38204 (J;NL)
Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look, 12:38147 (R;US)
Theoretical understanding of charm decays, 12:38191 (RA;US)
**Biljetina, R.,** *See* Anderson, G.L., 12:37011
**Billone, M.C.,** *See* Fee, D.C., 12:37010
*See* Goretta, K.C., 12:37306
**Bilodeau, E.A.,** Design of the small community program (SCSE #2) at Molokai, Hawaii, 12:36677 (BA;US)
**Bilstad, T.,** Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**Bingham, C.E.,** Effects of exposure testing on pipe insulation, 12:36692 (BA;US)
*See* Farrington, R.B., 12:36693
**Binkley, J.S.,** *See* Raghavachari, K., 12:37409
**Binkowski, F.S.,** *See* Patrinos, A.A.N., 12:37664
**Biondi, F.,** Method to obtain thin cross-sections for tree-ring analysis, 12:38036 (RA;US)
**Birdsall, C.K.,** Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)
**Biringer, K.L.,** Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**Bischoff, K.B.,** Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)
**Bisognano, J.J.,** Multipass beam breakup in the CEBAF [Continuous Electron Beam Accelerator Facility] superconducting linac, 12:37541 (R;US)
*See* Grunder, H.A., 12:37532
**Bistline, R.W.,** Maintaining occupational review programs using the flow Gemini system, 12:37933 (R;US)
**Bitensky, M.W.,** *See* Nagao, S., 12:37879
**Bitter, M.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38346, 12:38382
**Bivins, R.,** *See* Martz, H., 12:36418
**Bizzarri, U.,** Increase of current from 35 to 120 mA of the 20 MeV Frascati microtron, 12:37482 (R;IT)
**Bjorken, J.D.,** Changing view of hadron structure, 12:38195 (RA;US)
Recent axion searches, 12:38142 (RA;US)
**Black, D.A.,** *See* Bonzon, L.L., 12:36918
**Black, F.M.,** *See* Hoffman, J.S., 12:37635
**Black, P.S.,** Tests of the TRAC code against known analytical solutions for stratified flow, 12:36881 (RA;US)
**Blackman, H.S.,** *See* Meyer, O.R., 12:36920
**Blair, M.S.,** *See* Berven, B.A., 12:37819
**Blakely, E.A.,** *See* Kraft, G., 12:37904
**Blakely, K.A.,** *See* Shaffer, P.T.B., 12:37282

**Blanchard, W.R.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Blanco, J.,** *See* Alonso, A., 12:36878
**Bledsoe, J.,** *See* Berry, L., 12:37026, 12:37078
**Bleem, J.,** Night ventilation strategies in dry climates, 12:36694 (BA;US)
**Bleier, A.,** Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
*See* Baik, S., 12:37308
**Blessing, G.V.,** *See* Clark, A.V. Jr., 12:37264
**Bleszynski, M.,** Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**Blink, J.A.,** *See* Summers, M.A., 12:37487
**Bloemen, H.,** *See* Silk, J., 12:38077
**Blomquist, R.,** *See* Saboungi, M., 12:37246
**Blonigen, S.J.,** *See* Hoover, M.D., 12:37616
**Bloodwell, J.M.,** *See* Pritchard, P.C.H., 12:36551
**Bloom, G.R.,** *See* Muhlestein, L.D., 12:36899
**Bloom, T.,** *See* Brown, D.P., 12:36480
**Boatner, L.A.,** *See* Christen, D.K., 12:37291
*See* Sales, B.C., 12:37331
*See* Shinn, M.D., 12:37474
**Bober, A.,** *See* Brosch, G., 12:37099
**Bobis, J.P.,** Advanced research in instrumentation and control technology: capacitance flowmeter, 12:36243 (RA;US)
*See* Sheen, S.H., 12:36306
**Boccio, J.L.,** Plant lifetime reliability and risk: Addressing today's strategies for making tomorrow's decisions, 12:36823 (R;US)
**Bodwin, G.T.,** Unorthodox lattice fermion derivatives and their shortcomings, 12:38214 (R;US)
**Boecker, B.B.,** Annual report references to dog longevity studies in which all dogs have died, 12:37909 (RA;US)
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}$Ce. XII, 12:37916 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble form by Beagle dogs XIX, 12:37913 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
*See* Gillett, N.A., 12:37910
*See* Guilmette, R.A., 12:37920
*See* Hahn, F.F., 12:37908, 12:37923
*See* Lundgren, D.L., 12:37925
*See* Mewhinney, J.A., 12:37918
*See* Muggenburg, B.A., 12:37917, 12:37919, 12:37921
**Boegl, W.,** *See* Hammermaier, A., 12:37438, 12:37439
*See* Schnell, R., 12:37440
*See* Schuettler, C., 12:37898, 12:37899
**Boehm, R.,** A flux-on method for determining thermal losses from solar central receivers, 12:36663 (BA;US)
**Boggiano, A.,** *See* Fontana, P., 12:37111
**Bogner, J.,** Gas pressure and concentration gradients at the top of a landfill, 12:37824 (R;US)
**Bohn, M.S.,** Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
**Boiano, J.M.,** Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York, 12:37689 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
*See* Almaguer, D., 12:37695, 12:37702
**Bolland, T.K.,** *See* Rokhlin, S.I., 12:37362
**Bond, J.A.,** Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
*See* Martin, O.S., 12:37980
**Bonner, B.E.,** *See* Phillips, G.C., 12:38121
**Bonoff, M.B.,** National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)
**Bonvicini, G.,** *See* Alexander J., 12:38168
**Bonzon, L.L.,** Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**Book, D.L.,** NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**Booker, C.P.,** Nuclear plant data bank, 12:36870 (RA;US)
**Boozer, A.,** *See* Reiman, A., 12:38367
**Boreck, D.L.,** Thick-seam mining in the Western United States--geological considerations. Information Circular/ 1986, 12:36343 (R;US)
**Boresjoe, L.,** Multi-temporal Landsat data for detection and mapping of forest damage. Experiences from a test area in Schwarzwald, West Germany, 12:37729 (RA;DE)
**Borg, H.M.,** *See* Poulson, R.E., 12:36473, 12:36474
**Borg, R.J.,** *See* Lindner, M., 12:38257
**Bork, R.,** The CEBAF [Continuous Electron Beam Accelerator Facility] control system architecture, 12:37531 (R;US)
**Borovsky, J.E.,** Limits on the cross-field propagation of streams of cold plasma, 12:38360 (J;US)
*See* Baber, D.N., 12:38072
**Borsella, E.,** Materials depositions produced by laser radiation, 12:37481 (R;IT;In Italian)
**Borton, D.N.,** *See* Bilodeau, E.A., 12:36677
**Bosch, F.,** *See* Tsertos, H., 12:38095
**Boshier, J.F.,** Four futures: energy implications of social and economic change, 12:36952 (R;NZ)
**Bosnak, R.J.,** Role of oversight within NRR and its effect on industry, 12:36893 (RA;US)
**Bossanyi, E.A.,** Adaptive pitch control of a 25m wind turbine generator, 12:36740 (R;GB)
**Bossert, J.E.,** *See* Reiter, E.R., 12:37725
**Bostian, H.E.,** *See* Dykes, R.M., 12:37158
**Boston, H.L.,** Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary, 12:37838 (R;US)
**Botto, R.E.,** *See* Hayatsu, R., 12:36294
**Boucher, J.,** *See* Smeers, Y., 12:36435
**Bougault, R.,** Intermediate-mass fragments from nonbinary processes in the reaction of /sup 14/N on Ag at E/A = 35 MeV, 12:38254 (J;US)
**Boughton, B.D.,** *See* Ratzel, A.C., 12:36712
**Bouillard, J.X.,** *See* Lyczkowski, R.W., 12:36352
**Bouteca, M.J.,** Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment, 12:36393 (BA;US)
**Bova, L.,** *See* Cho, D.H., 12:37390
**Bowden, G.,** Beam position measurements at the SLC IP, 12:37552 (RA;US)
**Bower, J.M.,** Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
**Bowers, L.J.,** Variations of the standard error/mean index ratio on wetland sites, 12:37763 (RA;US)
**Bowler, B.,** Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)
**Bowles, K.J.,** *See* Garcia, D., 12:37346
**Bowles, T.J.,** Limit on the anti $\nu$ mass in free molecular tritium beta decay, 12:38152 (BA;DE)
*See* Knapp, D.A., 12:38236
**Bowman, C.D.,** Proposal for a high sensitivity search for T-violation in slow neutron resonances, 12:38284 (BA;DE)
**Bowman, J.D.,** *See* Bowman, C.D., 12:38284
**Bown, J.R.,** Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)
**Boyack, B.E.,** Analysis results from the Los Alamos 2D/3D program, 12:36863 (RA;US)
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)
**Boyarski, A.,** *See* Banks, T., 12:38181
**Boyer, P.D.,** *See* Kandpal, R.P., 12:37866
**Braby, L.A.,** *See* Brackenbush, L.W., 12:37932
**Brackenbush, L.W.,** Microdosimetric basis for exposure limits, 12:37932 (R;US)
**Bradley, D.J.,** Spent fuel performance in geologic repository environments, 12:36530 (R;US)
**Braeker, O.U.,** Environmental stresses and residual variation in European tree-ring data after climatic influence is removed, 12:38030 (RA;US)
Trace element analysis of wood, a tool for monitoring air pollution, 12:37796 (RA;DE)
**Braganza, C.,** *See* Gasser, L., 12:38413
**Brager, H.R.,** *See* Simons, R.L., 12:37220
**Braginski, A.I.,** Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
*See* Ekin, J.W., 12:37288
**Bragninski, A.I.,** Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)

**Braithwaite, J.W.,** *See* Magnani, N.J., 12:36944
**Bramlette, T.T.,** *See* Keller, J.O., 12:37523
**Branagan, P.T.,** Case history of hydraulic fracture performance in the naturally fractured Paludal zone: The transitory effects of damage, 12:36457 (BA;US)
**Branco, G.C.,** Phenomenological clues for discrete symmetries in superstring theories, 12:38211 (J;US)
**Brand, B.,** *See* Mandl, R.M., 12:36843
**Brandenburg, C.,** *See* Mc Fall, K.S., 12:36447
**Brandenburg, J.A.,** *See* Lindsay, C.N., 12:36563
**Branscomb, E.W.,** *See* Mohrenweiser, H.W., 12:38007
**Braun, H.,** Optimized load distribution in supply systems with combined heat and power generation in consideration of the district heating network, 12:37146 (R;DE;In German)
**Braun-Munzinger, P.,** *See* Sohlbach, H., 12:38260
**Bray, P.J.,** *See* Brinker, C.J., 12:37316
**Breakall, J.K.,** *See* Latorre, V.R., 12:37466
**Brechtel, C.E.,** *See* Adam, M.E., 12:36465
**Breen, S.P.,** Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
**Bregman, M.,** *See* Baker, N.J., 12:38243
**Breidenbach, M.,** Data acquisition for high energy physics experiments, 12:37553 (RA;US)
**Breiland, W.G.,** *See* Coltrin, M.E., 12:37430
**Brenkert, A.L.,** *See* Bartell, S.M., 12:37833
**Brennan, T.,** Monitoring before and after radon mitigation, 12:37719 (R;US)
**Brennan, T.M.,** *See* Zipperian, T.E., 12:37517
**Brettel, H.,** *See* Aderholz, M., 12:37565
**Bretz, N.L.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Bridenbaker, W.A.,** Decontamination of the Scrap Removal Room at the West Valley Demonstration Project, 12:36508 (R;US)
**Bridge, M.,** Management effects in British tree-ring series, 12:37757 (RA;US)
**Bridge, R.,** *See* Nolen, S.L., 12:37157
**Brigham, W.E.,** *See* Falade, G.K., 12:36383
*See* Mahmood, S.M., 12:36384
**Brindza, P.,** An optimized input waveguide for the CEBAF [Continuous Electron Beam Accelerator Facility] Superconducting Linac Cavity, 12:37549 (R;US)
*See* Biallas, G., 12:37548
**Brinker, C.J.,** Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)
**Brisbane, T.,** *See* Anand, D.K., 12:36700
*See* Lof, G.O.G., 12:36697
**Brisbane, T.E.,** *See* Helferty, J.J., 12:36717
**Brister, G.H.,** Sampling for branch, tree and stand estimates of crown biomass, 12:37786 (RA;DE)
**Brittain, I.,** *See* Wolfert, K., 12:36873
**Britton, K.,** Brittle fracture phenomena: An hypothesis, 12:38048 (R;US)
**Brna, T.G.,** *See* Chang, J.C.S., 12:37653
*See* Jozewicz, W., 12:36331, 12:37669
**Brockmann, J.E.,** *See* Tarbell, W.W., 12:36910
**Brodsky, S.J.,** Testing quantum chromodynamics in electroproduction, 12:38197 (R;US)
**Brodzinski, R.L.,** Achieving ultralow background in a germanium spectrometer, 12:37569 (R;US)
*See* Avignone, F.T. III, 12:38248
**Brooker, H.R.,** *See* Oural, C.R., 12:37851
**Brooks, A.L.,** Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
*See* Guilmette, R.A., 12:37927
*See* Hahn, F.F., 12:37929
*See* Pickrell, J.A., 12:37971
**Brosch, G.,** Non-federal funding for transit systems: state-of-the-art case analyses. Final report, 1983-1985, 12:37099 (R;US)
**Brosey, W.D.,** Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)
**Broughton, J.M.,** *See* Tolman, E.L., 12:36896
**Brown, D.,** *See* Griffith, P., 12:36852
**Brown, D.P.,** Mortality among uranium enrichment workers, 12:36480 (R;US)
**Brown, D.R.,** Cost drivers for solar thermal central receiver power plants, 12:36661 (BA;US)
*See* Drost, M.K., 12:36939
*See* Williams, T.A., 12:36672
**Brown, H.D.,** Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)
**Brown, K.E.,** *See* Meng, H.Z., 12:36391
**Brown, K.J.,** Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
**Brown, M.,** *See* Molton, P., 12:36589
**Brown, M.T.,** Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**Brown, R.E.,** *See* Cizewski, J.A., 12:38262
**Brown, S.,** *See* Gillett, N.A., 12:37876
**Browne, J.C.,** *See* Bowles, T.J., 12:38152
*See* Knapp, D.A., 12:38236
**Brubaker, L.B.,** Forest disturbance and tree-ring analysis, 12:37744 (RA;US)
*See* Graumlich, L.J., 12:37942
**Bruck, R.I.,** Effects of acid precipitation on plant diseases, 12:37999 (R;US)
**Bruckner, L.,** *See* Martz, H., 12:36418
**Brugger, R.M.,** *See* Batigun, C.M., 12:38292
**Bruggink, D.J.,** Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
**Bruneau, C.L.,** *See* Davis, L.J., 12:37081
**Brunk, J.A.,** *See* Noshkin, V.E., 12:37852
**Brust, F.,** *See* Wilkowski, G.M., 12:36804
**Bryan, W.E.,** *See* Swain, D.W., 12:38374
**Bryant, M.P.,** *See* Krumholz, L.R., 12:38009
**Brynestad, J.,** *See* Bentley, J., 12:37290
*See* Thompson, J.R., 12:37294
**Buchanan, A.C. III,** Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms, 12:36296 (R;US)
**Buchanan, J.P.,** *See* Bruggink, D.J., 12:37856
**Buchmueller, W.,** Strong CP problem and the visibility of invisible axions, 12:38156 (R;DE)
**Bucholz, J.A.,** Shielding methods for evaluating the versatility of proposed shipping casks, 12:37453 (R;US)
**Buck, O.,** Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
*See* Ranjan, R., 12:37267
**Buckley-Golder, D.H.,** Contribution of renewable energy technologies to future energy requirements, 12:37004 (J;GB)
**Budd, K.D.,** The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Buddemeier, R.W.,** Tritium in groundwater at Site 300, 12:37853 (R;US)
**Budny, R.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Bueche, G.,** Annual report on nuclear physics activities. July 1, 1985-June 30, 1986, 12:38231 (R;DE)
**Buechl, K.,** *See* Watt, R.G., 12:38386
**Buerger, J.,** *See* Behrend, H.J., 12:38116
**Builtjes, P.J.H.,** *See* Klug, W., 12:37598
**Buksa, E.,** *See* Paez, T.L., 12:37508
**Bukur, D.B.,** *See* Withers, H.P., 12:36582
**Bullin, J.A.,** User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)
**Bullock, C.A.,** Membranes improve insulation efficiency, 12:37030 (RA;US)
**Bulos, F.,** Some fast beam kicker magnet systems at SLAC, 12:37554 (R;US)
**Bunce, G.M.,** *See* Sullivan, M.W., 12:38151
**Bunick, G.,** *See* Voet, D., 12:37861
**Bunker, B.C.,** Solution chemistry of silicate and borate materials, 12:37323 (BA;US)
**Bunshah, R.F.,** *See* Kaufherr, N., 12:37286
**Bunting, B.G.,** *See* Lauer, J.L., 12:37344
**Bunz, H.,** *See* Kanzleiter, T., 12:36902
**Burchat, P.,** Status of Monte Carlos for a tau pair production at SLC, 12:38170 (RA;US)
**Burchell, S.L.,** *See* Chiappetta, R.F., 12:36346
**Burd, A.B.,** *See* Stein-Schabes, J.A., 12:38058
**Burfield, L.J.,** Oxygen enrichment of continuous reheat furnace to increase productivity and reduce fuel consumption, 12:37119 (RA;SE)
**Burgardt, P.,** *See* Heiple, C.R., 12:37234
**Burger, L.L.,** *See* Scheele, R.D., 12:36489
**Burges, S.J.,** *See* Lettenmaier, D.P., 12:36610
**Burke, D.,** *See* Bowden, G., 12:37552
**Burke, D.G.,** *See* Cizewski, J.A., 12:38262
**Burkert, V.,** Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
**Burkert, V.D.,** Spin degrees of freedom in electron nucleon scattering in the resonance region, 12:38124 (R;US)
**Burman, J.,** *See* Watson, R.H., 12:37059
**Burns, F.B.,** Comparison study of search algorithms and data base libraries for

compound identification from mass spectral data, 12:37380 (R;US)
**Burns, J.M.,** *See* Telewski, F.W., 12:38032
**Burns, J.O.,** *See* Baber, D.N., 12:38072
**Burns, P.,** *See* Bleem, J., 12:36694
**Burns, P.J.,** *See* Kirkpatrick, A.T., 12:36695
**Burrage, L.M.,** Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Burris, A.,** *See* Martz, H., 12:36418
**Burris, B.,** *See* Evens, A., 12:37037
*See* Katrakis, J., 12:37044
**Burritt, T.H.,** *See* Knapp, D.A., 12:38236
**Burton, T.M.,** Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Busch, D.A.,** *See* Paradies, M.W., 12:36825
**Busch, D.E.,** *See* Fee, D.C., 12:37010
*See* Kaufherr, N., 12:37286
**Busch, J.F.,** Cross-comparisons of new energy-efficient houses, 12:37031 (RA;US)
**bush, C.E.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Bush, D.M.,** *See* Magnani, N.J., 12:36944
**Butcher, R.J.,** The spectroscopy and structure of novel high energy-high density compounds: Final progress report, May 1, 1985-July 31, 1986, 12:37391 (R;US)
**Butler, D.R.,** *See* Shroder, J.F. Jr., 12:37751
**Butler, P.C.,** *See* Magnani, N.J., 12:36944
**Butler, T.A.,** *See* Baker, W.E., 12:36805
**Butner, R.S.,** *See* Elliott, D.C., 12:36591
**Buttner, W.J.,** *See* Zaromb, S., 12:37957
**Button-Shafer, J.,** *See* Hicks, R.S., 12:38240
**Butzke, R.,** Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Buxton, L.D.,** *See* Kmetyk, L.N., 12:36880
**Byers, C.H.,** *See* Bienkowski, P.R., 12:37860
**Byers, R.K.,** *See* Kmetyk, L.N., 12:36880

## C

**Cabbil, C.C.,** Protective clothing use at the Savannah River Plant Nuclear Facility, 12:37457 (R;US)
**Cabela, E.,** Bilateral information meeting Hungary-Austria, subject 'forest decline', 12:37989 (R;DE;In German)
**Cairns, J.,** *See* Pratt, J.R., 12:37841
**Caldwell, D.O.,** Status of double beta decay of Ge, 12:38250 (BA;US)
**Caldwell, W.M.,** *See* Merriweather, R., 12:37372
**Callas, J.L.,** *See* Abe, K., 12:38115
*See* Ahrens, L.A., 12:38150
**Callen, J.D.,** *See* Goldston, R.J., 12:38351
**Calo, J.M.,** Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 December 1986-15 March 1987, 12:36271 (R;US)
**Caloi, R.,** *See* Dattoli, G., 12:37478
**Camacho, F.,** *See* Greenwald, M., 12:38326
**Cameron, C.P.,** The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
**Campostrini, M.,** Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)
**Cangelosi, G.A.,** Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions, 12:37865 (J;US)
**Cannon, R.M.,** *See* Bleier, A., 12:37315
**Capone, D.W.,** *See* Ekin, J.W., 12:37288
**Capone, D.W. II,** Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials, 12:37287 (R;US)
*See* Rudman, D.A., 12:37283
**Cappiello, M.W.,** *See* Boyack, B.E., 12:36863
*See* Spore, J.W., 12:36867
**Caputo, A.J.,** *See* Lowden, R.A., 12:37301
**Carek, G.A.,** Shot peening for Ti-6Al-4V alloy compressor blades, 12:37229 (R;US)
**Carli, G.,** Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
**Carlson, D.D.,** *See* DeBey, T.M., 12:36806, 12:36930
*See* DuCharme, A.R., 12:36929
**Carlson, N.M.,** Ultrasonic detection of weld bead geometry, 12:37270 (BA;US)
**Carneiro, C.M.R.,** Monitoring the modifications in the forest ecosystem of the Brazilian Amazon region through remote sensing techniques, 12:37938 (RA;DE)
**Carolan, R.A.,** The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)
**Carpenter, S.H.,** *See* Heiple, C.R., 12:37233
**Carr, J.A.,** *See* Mellema, S., 12:38246
*See* Rapaport, J., 12:38241
*See* Van Verst, S.P., 12:38276
**Carr, W.J.,** *See* Dixon, G.L., 12:36509
**Carreras, B.A.,** *See* Holmes, J.A., 12:38332
**Carroll, D.E.,** *See* Bergeron, K.D., 12:36912
*See* Murata, K.K., 12:36901
**Carstea, D.D.,** *See* Habegger, L.J., 12:36799
**Carter, G.R.,** *See* Trimble, J.L., 12:37859
**Carter, H.R.,** Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
**Carter, J.P.,** Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Carter, R.P.,** *See* Gaynor, A.J., 12:36459
**Carter, W.C.,** *See* Trimble, J.L., 12:37859
**Carter, W.P.L.,** *See* Lurmann, F.W., 12:37660, 12:37661
**Casassa, E.Z.,** *See* Atlas, H., 12:36360
**Casleton, K.H.,** Laser-induced fluorescence detection of mineral vaporization species, 12:36358 (RA;US)
**Cassel, R.L.,** *See* Bulos, F., 12:37554
**Cassidy, J.,** *See* Gillett, N.A., 12:37876
**Castaldini, C.,** Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)
**Castanier, L.M.,** *See* Ramage, W.E., 12:36382
**Castellani, C.,** Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems, 12:38219 (R;IT)
**Castellano, C.C.,** Open-cycle ocean thermal energy conversion-experimental program development, 12:36679 (BA;US)
**Castellano, S.M.,** Temperature dependence of the electron spin resonance spectra of a coal-derived vacuum distillation residue and components, 12:36320 (J;US)
**Casten, R.F.,** Symmetries in heavy nuclei and the proton-neutron interaction, 12:38286 (BA;US)
**Castillo, J.L.,** Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)
**Castle, J.A.,** Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1, 12:36647 (R;US)
**Castro, R.,** Creep of austenitic stainless steels at room temperature, 12:37256 (TG;US)
**Catalano, J.,** *See* Eskridge, R., 12:37624
**Cataldo, D.A.,** *See* Van Voris, P., 12:37816
**Catlin, T.,** *See* Katrakis, J., 12:37044
**Caton, J.E.,** *See* Merriweather, R., 12:37372
*See* Tomkins, B.A., 12:37371
**Cazzoli, E.,** *See* Khatib-Rahbar, M., 12:36905
**Cetegen, B.M.,** Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
**Chakraborty, P.C.,** *See* Ramachandran, N., 12:37108
**Chambers, R.R. Jr.,** Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)
**Champion, K.,** Middle atmosphere density and models. Technical report, 12:38080 (R;US)
**Chan, Y.,** Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**Chance, M.S.,** *See* Cheng, C.Z., 12:38366
**Chandrashekar, M.,** Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Chang, C.C.,** Short range phenomena, 12:38161 (R;US)
**Chang, E.Y.,** Conduction of heat from a planar wall with uniform surface temperature to a monodispersed suspension of spheres, 12:37503 (J;US)
**Chang, J.C.S.,** Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for

September 1985-April 1986, 12:37653 (R;US)
*See* Jozewicz, W., 12:36331, 12:37669
**Chang, L.K.,** Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels, 12:36933 (BA;US)
**Chang, S.G.,** *See* Littlejohn, D., 12:36330
*See* Liu, D.K., 12:36329
**Chang, S.h.,** Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100), 12:37353 (J;US)
**Chang, Y.,** Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**Chao, K.C.,** *See* Leet, W.A., 12:37418
**Chari, M.V.K.,** Improvement in accuracy of prediction of electrical machine constants and generator models for subsynchronous resonance conditions: Volume 3, Development and benefit assessment of finite-element-based saturation model: Final report, 12:36753 (R;US)
**Charkey, A.,** *See* Viswanathan, S., 12:36940
**Charlez, P.,** *See* Despax, D., 12:36396
**Charlton, J.C.,** Kinematic tests of exotic flat cosmological models, 12:38075 (J;US)
**Charpentier, R.R.,** Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)
**Chatterjee, A.,** Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel, 12:37261 (J;US)
**Chau, L.L.,** Status of electroweak theory for heavy quark decays and CP violation, 12:38209 (BA;DE)
**Chavez, E.,** *See* Chan, Y., 12:38261
**Chegini, H.,** *See* Singh, J.J., 12:36462
**Cheli, U.,** *See* Beretta, A., 12:36645
**Chen, B.,** Geothermal research at the Puna Facility, 12:36731 (R;US)
**Chen, B.T.,** Cigarette smoke aerosol in a Walton smoke machine, 12:37614 (RA;US)
Design criteria of a virtual impactor, 12:37612 (RA;US)
Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier, 12:36337 (RA;US)
**Chen, F.C.,** *See* Griffin, F.P., 12:37025
**Chen, G.L.,** *See* Owens, T.L., 12:38371
**Chen, J.K.,** Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
**Chen, K.Y.,** *See* Wu, E.J., 12:36328
**Chen, L.,** Effect of liquids on the Drude dielectric function of Ag and Au films, 12:37251 (J;US)
**Chen, Q.,** Orbit extension method for finding unstable orbits, 12:38333 (R;US)
**Chen, W.R.,** Branching, geometrical scaling, and Koba-Nielsen-Olesen scaling, 12:38200 (J;US)
**Cheney, J.L.,** Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
*See* Eatough, D.J., 12:37645
**Cheng, C.Z.,** Eigenmode analysis of compressional waves in the magnetosphere, 12:38350 (R;US)
NOVA: A nonvariational code for solving the MHD stability of axisymmetric toroidal plasmas, 12:38366 (J;US)
**Cheng, H.S.,** Emergency response training with the BNL plant analyzer, 12:36811 (R;US)
*See* Wulff, W., 12:36869
**Cheng, J.C.,** Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987, 12:36270 (R;US)
**Cheng, L.J.,** *See* Urbana, C.S., 12:36641
**Cheng, S.,** *See* Long, A., 12:37604
**Cheng, T.C.,** *See* Allison, C.M., 12:36908
**Cheng, Y.S.,** Deposition of ultrafine particles on a human nasal cast, 12:37960 (RA;US)
Drag force and slip correction factor of aggregates measured in a Millikan apparatus, 12:37613 (RA;US)
*See* Su, Y.F., 12:37713
**Cherniak, M.G.,** *See* McManus, K.P., 12:37680
**Chess, E.K.,** *See* Smith, R.D., 12:36301
**Chesshire, J.,** A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)
**Chhabildas, L.C.,** Dynamic quasi-isentropic compression of tungsten, 12:37241 (R;US)
**Chi, W.K.,** Effect of pore structure on the char-steam reaction, 12:36287 (B;US)
**Chiang, C.J.,** SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
*See* Dirks, J.A., 12:36662
**Chiang, K.T.,** *See* Perkins, R.A., 12:37198
**Chiang, S.H.,** *See* Melkus, T.G., 12:36292, 12:36293
**Chiappetta, R.F.,** Effects of accurate MS delays on productivity, energy consumption at the primary crusher, oversize, ground vibrations and airblast, 12:36346 (BA;US)
**Chiche, P.,** Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)
**Chin, B.A.,** *See* Levy, I.S., 12:36494
**Chisholm, W.P.,** *See* Castellano, S.M., 12:36320
*See* McCarty, D.L., 12:36300
**Chitwood, C.B.,** *See* Bougault, R., 12:38254
**Chiu, C.L.,** *See* Hwang, C.C., 12:36269
**Cho, D.H.,** Dynamic behavior of reacting gas jets submerged in liquids, 12:37390 (R;US)
**Choo, Y.K.,** Transient pressure behavior of multiple-fractured gas wells, 12:36456 (BA;US)
**Choquard, Ph.,** Dielectric susceptibility of classical Coulomb systems. II, 12:38304 (J;US)
**Chou, G.F.,** Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)
**Choudhury, A.,** *See* Chatterjee, A., 12:37261
**Chow, T.K.,** *See* O'Hara, J.B., 12:36241
**Chowdhury, P.,** *See* Williams, M.L., 12:36777
**Chrien, R.E.,** Electromagnetic transitions in hypernuclei, 12:38242 (BA;DE)
Studies of hypernuclei by associated production, 12:38237 (R;US)
*See* Siemon, R.E., 12:38341
**Christen, D.K.,** Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/$CuO_4$, 12:37291 (R;US)
*See* Thompson, J.R., 12:37212, 12:37294
**Christensen, E.,** Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)
**Christensen, J.J.,** *See* Eatough, D.J., 12:36260
**Christensen, K.,** Tree-rings and insects: the influence of cockchafers on the development of growth rings in oak trees, 12:37745 (RA;US)
**Christian, T.L.,** *See* Myer, L.R., 12:36522
**Christianson, C.C.,** *See* Miller, J.F., 12:36947
**Christophorou, L.G.,** Effect of temperature on nondissociative electron attachment to molecules, 12:37388 (R;US)
**Chu, B.B.,** Use of probabilistic systems analysis for enhancing plant operational safety and productivity, 12:36891 (RA;US)
**Chu, C.W.,** *See* Hor, P.H., 12:37359
**Chuah, Y.K.,** Terminal concentrators for solar central receiver applications, 12:36669 (BA;US)
**Chuma, N.J.,** *See* White, A.F., 12:37823
**Chupp, E.L.,** High-energy neutral radiations from the sun, 12:38051 (R;US)
**Cicero, D.C.,** High-temperature control of contaminants in coal-derived gases, 12:36283 (BA;US)
**Cillo, D.L.,** *See* Narain, N.K., 12:36282
*See* Tischer, R.E., 12:36279
**Ciocci, F.,** Spontaneous emission in Cerenkov FEL devices: a preliminary theoretical and experimental analysis, 12:37479 (R;IT)
Spontaneous emission in a double dielectric slab for Cerenkov-FEL operation, 12:37480 (R;IT)
**Cipolla, C.L.,** *See* Branagan, P.T., 12:36457
**Cizewski, J.A.,** Ir(t-arrow-right,$\alpha$)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)
**Clark, A.V. Jr.,** Use of ultrasonics for texture monitoring in aluminum alloys, 12:37264 (BA;US)
**Clark, C.F.,** Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986, 12:36937 (R;US)
**Clark, D.P.,** *See* Abdulrashid, N., 12:37870
**Clark, J.A.,** *See* Poulson, R.E., 12:36473
**Clark, J.H.,** Picosecond studies of multiphoton absorption: Final technical report, 12:37395 (R;US)
**Clark, R.G.,** *See* Yanosky, T.M., 12:38033
**Clark, R.P.,** *See* Magnani, N.J., 12:36944
**Clark, S.,** Potential for use of cottonwoods as indicators of past floods, 12:37831 (RA;US)
**Clarke, R.H.,** Investigation of the triplet state of chlorophylls: Final report,

May 1, 1975 through April 30, 1987, 12:36624 (R;US)
**Clayton, C.,** *See* Umstadter, D., 12:38365
**Clemons, L.,** *See* Bridenbaker, W.A., 12:36508
**Cler, G.,** *See* Lof, G.O.G., 12:36697
**Cletcher, J.W.,** *See* Minarick, J.W., 12:36921, 12:36922
**Clinkemaillie, J.,** *See* Despax, D., 12:36396
**Cloutman, L.D.,** New estimate of the mixing length and convective overshooting in massive stars, 12:38076 (J;US)
**Cobb, B.,** *See* Knepton, J., 12:38013
**Coburn, M.D.,** Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane, 12:37400 (R;US)
**Cocco, R.A.,** Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**Coe, J.M.,** Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces, 12:36321 (J;US)
**Coerr, S.,** Topical report on the meeting of the Gas Research Institute Indoor Air-Quality Research Advisory Committee. Final report, February 11-13, 1986, 12:37682 (R;US)
**Coffey, H.E.,** Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**Cohen, E.G.D.,** [Some basic research problems related to energy: Progress report], 12:38101 (R;US)
**Cohen, J.S.,** *See* Knapp, D.A., 12:38236
**Cohen, R.H.,** Effect of trapped electrons on current drive, 12:38358 (J;US)
**Cohen, S.A.,** *See* Goldston, R.J., 12:38351
*See* Hill, K.W., 12:38382
**Cole, R.L.,** Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**Colella, P.,** *See* Bell, J.B., 12:37502
**Colestock, P.L.,** *See* Batchelor, D.B., 12:38321
*See* Smithe, D.N., 12:38345
**Collier, D.E.,** SMUDPV2 quarterly performance report IV for the period January through March 1987, 12:36649 (R;US)
**Colligan, J.,** *See* Johnson, M., 12:36999
**Collin, R.,** *See* Vaclavinek, J., 12:37124
**Collins, C.B.,** Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986, 12:37473 (R;US)
**Collins, E.R.,** Coal slurry letdown device, 12:36245 (RA;US)
**Collins, N.E.,** Institutional Conservation Program Evaluation Project: Results of hospital survey pretest, 12:37017 (R;US)
*See* Bernard, M.J. III, 12:37016
**Collins, T.,** *See* Diebold, R., 12:37536
**Colmenares, C.A.,** Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures, 12:36603 (R;US)
**Colombo, P.,** *See* Dougherty, D.R., 12:36500
**Coltrin, M.E.,** Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)
*See* Kay, B.D., 12:38305
**Colvin, M.E.,** Quantum chemical methods for massively parallel computers, 12:38308 (R;US)
**Combs, S.K.,** *See* Hill, K.W., 12:38382
*See* Schuresko, D.D., 12:38372
**Compere, A.L.,** Stability and composition of palm, coconut and soy oil fatty acid microemulsion diesel fuels, 12:36605 (BA;US)
**Condie, K.G.,** Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**Conkey, L.E.,** Red spruce tree-ring density and growth decline, 12:37753 (RA;US)
**Conley, C.H.,** Analysis of a proposed NNWSI exploratory shaft slot test for tuff response, 12:36537 (R;US)
**Conley, E.F.,** *See* Bell, R.J., 12:36752
**Conlin, F.,** Options for reducing energy use in manufactured housing, 12:37032 (RA;US)
**Conn, R.E.,** *See* Austin, L.G., 12:36353
**Conner, W.D.,** *See* McElhoe, H.B., 12:37644
**Conner, W.H.,** Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
**Connolly, P.L.,** *See* Baker, N.J., 12:38243
**Constanta-Fanourakis, P.,** *See* Heinicke, P., 12:38410
**Conti, M.,** Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics, 12:37573 (J;NL)
**Conway, T.,** Promoter and nucleotide sequences of the Zymomonas mobilis pyruvate decarboxylase, 12:37867 (J;US)
**Cook, D.L.,** Progress in light ion beam fusion research on PBFA II, 12:38390 (J;GB)
**Cook, E.R.,** Disaggregation of tree-ring series for environmental studies, 12:37758 (RA;US)
**Cook, J.R.,** Environmental information document: New hazardous and mixed waste storage/disposal facilities at the Savannah River Plant, 12:36514 (R;US)
Environmental information document: Y Area, 12:36549 (R;US)
**Cook, K.V.,** Flaw density examinations of a clad boiling water reactor pressure vessel segment, 12:36773 (R;US)
**Cook, N.G.W.,** *See* Ewy, R.T., 12:38044
*See* Pyrack-Nolte, L.J., 12:38043
**Cook, R.L.,** *See* Sammells, A.F., 12:36578
**Cooke, R.R.,** *See* Barrett, J.P., 12:37784
**Coombs, J.,** *See* Meynell, P.J., 12:36587
**Coombs, M.,** *See* Stillwagon, T., 12:37500
**Coombs, M.G.,** *See* Stillwagon, T.L., 12:37138
**Coop, K.L.,** A neutron portal monitor for vehicles, 12:36562 (R;US)
**Cooper, J.,** *See* Alber, G., 12:38093
**Cooper, T.C.,** *See* Sheehy, J.W., 12:37685
**Cope, D.R.,** *See* Dacey, P.W., 12:37611
**Copsey, A.B.,** *See* Malkin, M.P., 12:36688
**Corbo, P.,** F-Area Seepage Basins: Environmental information document, 12:37826 (R;US)
**Corey, J.C.,** Remote sensing at Savannah River, 12:37825 (R;US)
**Correa, S.M.,** *See* Sundell, R.E., 12:37235
**Cost, J.R.,** Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Costas, P.P.,** *See* Schwope, A.D., 12:37449, 12:37451
**Costello, K.W.,** *See* Hemphill, R.C., 12:36993
**Costin, L.S.,** A finite element material model for microfracture-damaged brittle rock, 12:38047 (R;US)
**Couch, W.A.,** *See* Maxwell, C.R., 12:36673
**Couchman, D.D.,** *See* Phillips, A.M., 12:36448
**Coulter, R.L.,** *See* Hicks, B.B., 12:37648
**Coursey, B.M.,** *See* Inn, K.G.W., 12:37577
**Courtright, E.L.,** *See* Prater, J.T., 12:37303
**Coutant, R.W.,** *See* Spicer, C.W., 12:37686
**Covington, W.W.,** *See* Sutherland, E.K., 12:37756
**Cox, C.M.,** *See* Dutt, D.S., 12:36788
**Coyle, A.J.,** Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36496 (R;US)
*See* Eckert, J.L., 12:36497
**Coyle, T.D.,** *See* Hardman-Rhyne, K.A., 12:37312
**Coyner, L.A.,** *See* Lurmann, F.W., 12:37660, 12:37661
**Crabtree, G.W.,** The Fermi surface of CeSb, 12:37205 (R;US)
*See* Dunlap, B.D., 12:37206
**Craig, K.R.,** *See* Bajura, R.A., 12:36257
**Cramer, S.D.,** *See* Carter, J.P., 12:37634
**Crasemann, B.,** Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
**Craun, J.C.,** *See* Gray, R.H., 12:36367
**Crawford, R.L.,** *See* Krumholz, L.R., 12:38009
**Creber, G.T.,** Productivity in fossil forests, 12:38026 (RA;US)
**Creutz, M.,** Monte Carlo algorithms for lattice gauge theory, 12:38215 (R;US)
**Criegee, L.,** *See* Behrend, H.J., 12:38116
**Croff, A.G.,** *See* Kocher, D.C., 12:36524
**Crone, A.,** Tree-ring studies and the reconstruction of woodland management practices in antiquity, 12:38027 (RA;US)
**Crowder, S.,** *See* Piette, M.A., 12:37066
**Crowe, C.,** *See* Evans, G., 12:36708
**Cruikshank, D.P.,** Research in planetary studies and operation of the Mauna Kea Observatory. Semiannual progress report, January-December 1986, 12:38063 (R;US)
**Cuddihy, R.G.,** Characteristics of radioactive particles released from the

Chernobyl nuclear reactor, 12:36832 (RA;US)
Model analysis of respiratory tract clearance of particles inhaled by people, 12:37970 (RA;US)
*See* Lundgren, D.L., 12:37925
**Culley, G.E.,** *See* Weber, E.T., 12:36820
**Cummings, J.C.,** Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)
**Cummings, R.E.,** *See* Guffey, F.D., 12:36469
**Cundy, D.C.,** CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**Cunha, S.H.F.,** *See* Pereira, M.V.F., 12:36770
**Curlee, T.R.,** The economic feasibility of plastics recycling, 12:37129 (R;US)
**Curry, B.B.,** *See* Kempton, J.P., 12:37562
**Curtis, C.W.,** Catalytic coprocessing: Effect of catalyst type and sequencing, 12:36281 (J;US)
*See* Guin, J.A., 12:36317
**Curtis, L.A.,** *See* Gieseke, J.A., 12:36909
**Cushman, J.H.,** Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)
**Cutburth, R.W.,** Support assembly having three dimension position adjustment capabilities, 12:37471 (P;US)
**Cutts, D.,** *See* Abe, K., 12:38115
*See* Ahrens, L.A., 12:38150
*See* Lanou, R.E. Jr., 12:38118
**Cybulskis, P.,** *See* Gieseke, J.A., 12:36909
**Czarnecki, R.M.,** Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)

## D

**D'Arrigo, R.,** Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide, 12:37603 (RA;US)
**D'Ottavio, T.W.,** Radon source rate measurements using multiple perfluorocarbon tracers, 12:37709 (R;US)
*See* Hoogendyk, C.G., 12:37600
**Da Prat,** *See* Prado, L.R., 12:36406
**Dacal, A.,** *See* Chan, Y., 12:38261
**Dacey, P.W.,** Flue gas desulphurisation: system performance, 12:37611 (R;GB)
**Dahl, A.R.,** *See* Fischer, J.P., 12:37979
*See* Sabourin, P.J., 12:37976
**Dahl, D.A.,** *See* Appelhans, A.D., 12:37384
**Dahling, B.A.,** *See* Moran, M.J., 12:37509
**Dakhoul, Y.M.,** Computational analyses of crystal growth. Final report, 12:37345 (R;US)
**Dallman, R.J.,** Severe Accident Sequence Analysis Program: Anticipated transient without scram simulations for Browns Ferry Nuclear Plant Unit 1, 12:36919 (R;US)
**Dally, W.J.,** *See* Penfield, P., 12:38402
**Dalton, J.P.,** Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)
**Dancer, A.,** *See* Vassout, P., 12:38015
**Dane, K.E.,** *See* Voelker, R.P., 12:36424
**Danfors, B.,** New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
**Dangelo, N.,** *See* Gurnett, D.A., 12:38343
**Darnell, R.A.,** Semi-automated reviewing station for IAEA [International Atomic Energy Agency] optical surveillance data, 12:36568 (R;US)
**Date, A.R.,** *See* Lindner, M., 12:38257
**Datskos, P.G.,** *See* Christophorou, L.G., 12:37388
**Dattoli, G.,** Analytical treatment of Free Electron Laser in the long pulse limit, 12:37477 (R;IT)
Instability in a multimode Free Electron Laser: effects of electron energy drift, 12:37476 (R;IT)
Self-consistent classical analysis of a start-up in a Free Electron Laser, 12:37478 (R;IT)
*See* Ciocci, F., 12:37479, 12:37480
**Daugherty, S.R.,** *See* Gat, U., 12:36934
**Davidson, E.H.,** Management of emergency feedwater during natural circulation cooldown following a loss of offsite power scenario, 12:36850 (RA;US)
**Davies, D.R.,** *See* Roodhart, L.P., 12:36401
**Davilla, W.,** *See* Taylor, D.W., 12:37828
**Davis, H.T.,** *See* Seiler, F.A., 12:37620
**Davis, L.J.,** Technology diffusion of energy-related products in residential markets, 12:37081 (R;US)
*See* Smith, S.A., 12:37103
**Davis, N.C.,** Particle-size determination from local fallout. Master's thesis, 12:37587 (R;US)
**Davis, R.,** *See* Khatib-Rahbar, M., 12:36905
**Davis, R.F.,** *See* More, K.L., 12:37289
*See* Nixon, R.D., 12:37281
**Dawson, G.W.,** *See* Van Voris, P., 12:37816
**Dawson, J.T.,** Cold leg condensation in a large break LOCA using TRAC-PF1/MOD1, 12:36882 (RA;US)
**de Macario, E.C.,** *See* Macario, A.J.L., 12:37882
**de Madron, E.,** Effect of continuous positive and negative pressure breathing on the respiratory pattern of conscious rats, 12:37885 (RA;US)
**de Meulemeester, A.,** Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
**de Roocker, A.,** *See* de Meulemeester, A., 12:37647
**De Saussure, G.,** *See* Goldstein, M., 12:36808
**de Teramond, G.F.,** Charge asymmetry of the nuclear interaction and neutron-neutron scattering parameters, 12:38201 (J;US)
**De Vito, A.,** *See* Petrucci, M., 12:37215
**Dean, D.A.,** *See* Dalton, J.P., 12:37900
**Dean, K.C.,** Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**DeBey, T.M.,** Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)
**Dec, J.E.,** *See* Keller, J.O., 12:37523
**DeCicco, J.M.,** Domestic hot water service in Lumley homes: a comparison of energy audit diagnosis with instrumented analysis, 12:37033 (RA;US)
**Decker, A.D.,** Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs, 12:36446 (BA;US)
**Decker, C.E.,** *See* Wright, R.S., 12:37637
**Decker, G.,** Tranverse beam break up in a periodic linac, 12:37540 (R;US)
**Dees, D.W.,** *See* Fee, D.C., 12:37010
**deGrassie, J.S.,** *See* Evans, T.E., 12:38380
**DeGroot, W.F.,** *See* Richards, G.N., 12:36460
**Deichelbohrer, P.R.,** Hot tests of the small portable arc saw using an electromechanical manipulator, 12:36935 (BA;US)
**Deiss, K.-H.,** Influence of the electrolyte concentration on the absorption of the NO/sub x/ components N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ in aqueous solutions, 12:37526 (R;DE;In German)
**Del Guerra, A.,** *See* Conti, M., 12:37573
**del Guidice, M.,** *See* Arko, A.J., 12:37204
**Delagi, B.A.,** *See* Brown, H.D., 12:38404
**DeLaHunt, M.J.,** Retrofit considerations in the multifamily sector, 12:37034 (RA;US)
**Delameter, W.R.,** The Molten Salt Electric Experiment: A project overview, 12:36666 (BA;US)
**Deleplanque, M.A.,** *See* Voigt, M.J.A. de, 12:38258
**DelGrande, J.M.,** Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis, 12:38100 (R;US)
**Dell, T.R.,** Southern forest growth trends: air pollution influence studies and tree-ring analysis, 12:37943 (RA;US)
**Dellenbrant, J.-Aa.,** Background paper: Soviet energy policy, 12:36981 (RA;SE)
**Delmore, J.E.,** *See* Appelhans, A.D., 12:37384
**Delnon, R.J.,** Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis, 12:36739 (R;GB)
**Delorme, A.,** *See* Leuschner, H.H., 12:38025
**Delsanto, P.P.,** *See* Clark, A.V. Jr., 12:37264
**Delwaide, A.,** Tree-ring reconstruction of Indian-Cree tree harvesting in the area, Quebec, Poste-de-la-Baleine, 12:38029 (RA;US)
**Delzer, D.B.,** *See* McDaniel, E.W., 12:36502
**Demchenko, V.V.,** Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
**Demirgian, J.C.,** *See* Cole, R.L., 12:37527
**Dempsey, P.F.,** *See* Sammells, A.F., 12:36578

**Demyanovich, R.J.**, Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**Deniz, A.V.**, Plasma formation and equilibrium in a high $\beta$ tokamak, 12:38361 (J;US)
**Dennis, R.A.**, *See* Anderson, R.J., 12:36357
**Denstad, J.P.**, Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)
**Derwent, R.G.**, *See* Buckley-Golder, D.H., 12:37004
**Deshpandey, C.**, *See* Kaufherr, N., 12:37286
**Despax, D.**, On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)
**Deurbrouck, A.W.**, Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
*See* Taylor, S.R., 12:36234
*See* Wen, W.W., 12:36230
**Devenish, E.J.**, *See* Keville, B.J., 12:36633
**DeWees, W.G.**, *See* Logan, T.J., 12:37651
**Dewispelaere, W.**, *See* Roover, B. de, 12:37731
**Dey, S.K.**, *See* Budd, K.D., 12:37309
**Di Giorgio, G.**, Ethanol production from agricultural raw materials, 12:36992 (R;IT;In Italian)
**Di Marzo, M.**, *See* Almenas, K., 12:36846
**Diamantopoulos, J.**, *See* Margaris, N.S., 12:36630
**Diamond, P.H.**, *See* Holmes, J.A., 12:38332
**Diamond, R.C.**, *See* Wagner, B.S., 12:37058
**Diamond, R.M.**, *See* Voigt, M.J.A. de, 12:38258
**Diamond, W.I.**, *See* Grunder, H.A., 12:37532
**Diana, G.**, *See* Beretta, A., 12:36645
**Dicastro, C.**, *See* Castellani, C., 12:38219
**Dickinson, D.R.**, *See* Muhlestein, L.D., 12:36899
**Dickson, G.**, Low temperature heat recovery, 12:37104 (R;GB)
**Diebold, R.**, Conventional 20-TeV, 10-Tesla, p/sup +-/p colliders, 12:37536 (BA;US)
**Diegle, R.B.**, *See* Sorensen, N.R., 12:37258
**Diehl, J.F.**, Radioactivity in foods - Chernobyl and the consequences, 12:37817 (R;DE;In German)
**Diehl, J.R.**, *See* Pennline, H.W., 12:37412
**Diel, J.H.**, Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
*See* Guilmette, R.A., 12:37906
*See* Mewhinney, J.A., 12:37918
**Dietrich, F.S.**, *See* Mellema, S., 12:38246
**Dietrich-Buchecker, C.O.**, *See* Lehn, J.M., 12:36576
**Dietz, R.N.**, *See* D'Ottavio, T.W., 12:37709
*See* Hoogendyk, C.G., 12:37600
**Dietzel, H.J.**, Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
**Diffenbach, R.A.**, *See* Hedges, S.W., 12:36760
**Difilippo, F.C.**, Comments on remarks on the inadequacy of one-group heterogeneous theories for the interpretation of incore neutron noise in BWRs, 12:36776 (J;GB)
**DiMilia, R.A.**, *See* Ellingson, W.A., 12:37284
**Dimopolous, S.**, *See* Avignone, F.T. III, 12:38248
**Dinsmore, T.V.**, Vacuum still bottoms viscometer, 12:36289 (B;US)
**Dirks, J.A.**, Value/cost optimization of solar central receiver electric power plants, 12:36662 (BA;US)
*See* Williams, T.A., 12:36672
**Diver, R.B.**, *See* Ratzel, A.C., 12:36712
*See* Ziph, B., 12:36658
**Diwan, M.**, *See* Abe, K., 12:38115
*See* Ahrens, L.A., 12:38150
**Dix, W.R.**, NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)
**Dixon, G.L.**, Status of geologic investigations for nuclear waste disposal at the Nevada Test Site, 12:36509 (RA;US)
**Dixon, W.G.**, *See* Kempton, J.P., 12:37562
**Dobrzynski, L.**, Recent results from the UA1 experiment at CERN, 12:38131 (RA;US)
**Dodge, M.C.**, Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
**Doehner, J.**, *See* Freedman, S.J., 12:38153
**Doll, P.**, *See* Bueche, G., 12:38231
**Domin, D.**, *See* Zaromb, S., 12:37957
**Domingo, N.**, *See* Griffin, F.P., 12:37025
**Dominici, F.**, *See* Avella, R., 12:37607
**Donaldson, A.R.**, *See* Bulos, F., 12:37554
**Dop, H. van**, *See* Klug, W., 12:37598
**Dorfan, J.**, Experimental tests of quantum chromodynamics, 12:38146 (R;US)
Experimental tests of quantum chromodynamics, 12:38221 (RA;US)
**Dorfan, J.M.**, Future frontiers for $e^+e^-$ collisions: physics of SLC and LEP, 12:38145 (R;US)
**Doria, A.**, *See* Ciocci, F., 12:37479, 12:37480
**Dorm-Adzobu, C.**, Forestry and forest industries in Liberia. An example in ecological destabilization, 12:37897 (R;DE)
**Dorries, T.**, List processing software for the LeCroy 1821 Segment Manager Interface, 12:38409 (R;US)
VMS software for the Jorway-411 interface, 12:38408 (R;US)
**Doss, E.D.**, Advanced research in instrumentation and control technology: multiphase flow studies, 12:36244 (RA;US)
**Dotson, P.**, *See* Spore, J.W., 12:36867
**Dougherty, D.R.**, Accelerated Leach Test(s) Program: Annual report, 12:36500 (R;US)
**Doughas, D.R.**, Optics of beam recirculation in the CEBAF [Continuous Electron Beam Accelerator Facility] cw linac, 12:37542 (R;US)
**Douglas, J.M.**, *See* Terrill, D.L., 12:36412
**Dowdy, E.J.**, Radiation dosimetry through spectral definition, 12:37572 (J;NL)
**Downing, D.**, *See* Glickstein, R.J., 12:36969
**Downing, D.J.**, Intervention detection - a systematic technique for examining shifts in radial growth rates of forest trees, 12:37858 (RA;US)
**Doyle, S.M.**, Magnetosphere-ionosphere interaction studies. Final report, 11 July 1980-30 June 1984, 12:38083 (R;US)
**Doyle, T.W.**, Dendroecological approach for studying inter-tree competition, 12:37738 (RA;US)
Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions, 12:37952 (RA;US)
White alder growth and development: the effect of small hydroelectric projects in the Sierra Nevada of California, 12:36616 (RA;US)
**Dozois, C.G.**, *See* Sales, G.S., 12:38082
**Draeger, J.A.**, Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)
**Drell, P.**, *See* Alexander J., 12:38168
**Drost, M.K.**, Thermal Energy Storage Evaluation Program: 1986 annual report, 12:36939 (R;US)
*See* Williams, T.A., 12:36672
**Drotning, W.D.**, Thermal expansion of low-density microcellular foams, 12:37351 (R;US)
**Drucker, H.**, *See* Gray, R.H., 12:36367
**Drukier, A.K.**, *See* Avignone, F.T. III, 12:38248
**Drummond, P.D.**, *See* Ackerhalt, J.R., 12:38318
**du Payrat, C.N.**, *See* Bown, J.R., 12:36425
**DuBard, J.L.**, Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report, 12:37610 (R;US)
**Dubbers, D.**, *See* Freedman, S.J., 12:38153
**DuCharme, A.R.**, US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
*See* DeBey, T.M., 12:36806
**Duda, J.R.**, An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado, 12:36442 (BA;US)
**Dudley, V.E.**, *See* Cameron, C.P., 12:36687
**Duever, M.J.**, Cypress tree-ring analysis in relation to wetlands and hydrology, 12:37832 (RA;US)
Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies, 12:37762 (RA;US)
**Duffar, T.**, *See* Ricard, J., 12:36629
**Duffie, J.A.**, *See* Kummer, J.P., 12:36671
*See* Malkin, M.P., 12:36688
**Duffy, C.J.**, Statistical structure and filter characteristics of tritium fluctuations in fractured basalt, 12:36541 (J;US)
**Dufrane, K.F.**, Performance of ceramics in ring/cylinder applications, 12:37167 (B;US)
**Dugan, C.B.**, *See* Macario, A.J.L., 12:37882
**Dukes, E.C.**, *See* Sullivan, M.W., 12:38151
**Dun, J.W.**, Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling, 12:36595 (B;US)
**Duncan, J.D.**, Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)

**Dunlap, B.D.,** f-band narrowing in uranium intermetallics, 12:37206 (R;US)
*See* Arko, A.J., 12:37204
**Dunn, J.E.,** Statistical aspects of autoregressive models in the assessment of radon mitigation, 12:37717 (R;US)
**Dunn, P.F.,** *See* Schlenger, B.J., 12:36824
**Dunsworth, T.S.,** *See* Hewett, M.J., 12:37041
**Dupagne, A.,** Basic characteristics for low-cost houses in order to reduce the energy consumption for heating, 12:37068 (R;FR)
**Duplat, P.,** Problems concerning the French monitoring grid of forest decline, 12:37775 (RA;DE;In French)
**Dupoirieux, F.,** Theoretical study of the nonsteady combustion of composite fuel droplets, 12:37446 (TG;FR)
**Durbin, R.D.,** *See* Knight, T.J., 12:37881
**Durham, J.L.,** Nitric acid-air diffusion coefficient: experimental determination, 12:37639 (R;US)
Transition-flow reactor tube for measuring trace-gas concentrations, 12:37646 (R;US)
*See* Hicks, B.B., 12:37648
**Durisen, R.H.,** *See* Imamura, J.N., 12:38074
**Durkin, L.S.,** *See* Abe, K., 12:38115
**Dusek, J.,** *See* Fee, D.C., 12:37010
**Dusenbery, P.B.,** Generation of broadband noise in the magnetotail, 12:38081 (R;US)
**Dutt, D.S.,** Performance of refractory alloy-clad fuel pins, 12:36788 (R;US)
**Dutt, G.S.,** Conversion from central to apartment-level heating in multifamily buildings: the Asbury Park Village case study, 12:37035 (RA;US)
*See* DeCicco, J.M., 12:37033
**Dwight, A.E.,** YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)
**Dycus, D.L.,** Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir, 12:37846 (R;US)
*See* Bruggink, D.J., 12:37856
**Dyer, D.D.,** Effects of corona on heat transfer in an enclosure. Master's thesis, 12:38099 (R;US)
**Dykes, R.M.,** Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)

## E

**Eagle, R.J.,** *See* Noshkin, V.E., 12:37852
**Earey, D.A.,** Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report, 12:37102 (R;ZA)
**Easler, T.E.,** Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
*See* Fee, D.C., 12:37010
**Easter, R.C.,** *See* Hales, J.M., 12:37704
**Eastering, J.B.,** Status of U.S. nuclear waste disposal programs, 12:36543 (BA;US)
**Eaton, R.,** *See* Gaines, G.B., 12:37367
**Eatough, D.J.,** Identification of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate in the Los Angeles atmosphere, 12:37645 (R;US)
Thermodynamics of molecular interactions in coal liquids: Progress report for the period July-December 1986, 12:36260 (R;US)
**Eatough, N.L.,** *See* Eatough, D.J., 12:37645
**Eberly, J.H.,** *See* Ackerhalt, J.R., 12:38318
**Ebihara, M.,** Reheating furnace technology in Kawasaki steel corporation, 12:37115 (RA;SE)
**Ebrey, T.G.,** [Mechanism of proton pumping by bacteriorhodopsin], 12:36625 (R;US)
**Echenique, P.M.,** *See* Flores, F., 12:37276
*See* Gras Marti, A., 12:37277
**Eckenwalder, J.E.,** *See* McCaw, P.E., 12:37740
**Eckert, J.L.,** Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
*See* Coyle, A.J., 12:36496
**Eckert, P.,** Lessons learned and issues raised at the Sky Harbor photovoltaic project, 12:36650 (BA;US)
**Eckert, R.T.,** *See* Barrett, J.P., 12:37784
**Eckstein, D.,** On the application of dendrochronology for the evaluation of forest damage, 12:37797 (RA;DE)
**Economides, M.J.,** Observations and recommendations in the evaluation of tests of hydraulically fractured wells, 12:36405 (BA;US)
*See* Despax, D., 12:36396
**Edel, A.,** *See* Lehn, J.M., 12:36576
**Edwards, C.,** *See* Gac, F.D., 12:37300
**Efthimion, P.C.,** *See* Redi, M.H., 12:38344
**Egan, B.A.,** Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version), 12:37663 (R;US)
**Egan, M.R.,** Wood crib fires in a ventilated tunnel. Report of Investigations/1986, 12:36366 (R;US)
**Egloff, H.,** Control sampling for close-to-nature silviculture, 12:37804 (RA;DE;In German)
**Egmond, N.D. van,** *See* Klug, W., 12:37598
**Ehlermann, D.,** *See* Diehl, J.F., 12:37817
**Eichenberger, H.,** Cantonal surveys of forest disease to complement national programs, 12:37788 (RA;DE;In German)
**Eichorst, D.J.,** *See* Schwartz, R.W., 12:37314
**Eick, J.L.,** *See* Spanner, G.E., 12:36810
**Eidson, A.F.,** Relation of beryllium oxide properties to dissolution in vitro, 12:37404 (RA;US)
*See* Finch, G.L., 12:37403, 12:37617, 12:37965, 12:37972
*See* Guilmette, R.A., 12:37907, 12:37927
*See* Hoover, M.D., 12:37615, 12:37616
*See* Mauderly, J.L., 12:36476
**Eisch, J.J.,** Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86, 12:36266 (R;US)
**Eisler, R.,** Mercury hazards to fish, wildlife, and invertebrates: a synoptic review, 12:37998 (R;US)
**Ekin, J.W.,** Transport critical-current characteristics of $Y_1Ba_2Cu_3O$/sub x/, 12:37288 (R;US)
**Ekmann, J.M.,** Pneumatic transport of coal by steam, 12:36350 (B;US)
**El-Sayed, M.A.,** Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**Elefant, S.,** *See* Elliott, L.J., 12:37631
**Elias, L.,** *See* Dattoli, G., 12:37476
**Eliason, V.L.,** *See* McGrail, B.P., 12:36531
**Ellestad, T.G.,** *See* Durham, J.L., 12:37646
**Ellingson, W.A.,** Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
*See* Fee, D.C., 12:37010
*See* Sawicka, B.D., 12:37009
*See* Singh, J.P., 12:37292
**Elliott, D.C.,** Analysis of medium-BTU gasification condensates, June 1985-June 1986, 12:38006 (R;US)
Product analysis from direct liquefaction of several high-moisture biomass feedstocks, 12:36591 (R;US)
*See* Baker, E.G., 12:36592
**Elliott, L.J.,** Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)
**Elliott, S.R.,** *See* Moe, M.K., 12:38249
**Ellis, J.R.,** *See* Trimble, J.L., 12:37859
**Ellis, J.T.,** *See* Thompson, J.R., 12:37212
**Ellis, M.J.,** *See* Boshier, J.F., 12:36952
**Ellison, W.,** European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
**Elmore, D.,** *See* Norris, A.E., 12:36520
**Elrick, M.G.,** *See* Kmetyk, L.N., 12:36880
**Ely, J.W.,** *See* Holditch, S.A., 12:36440
**Emanuelson, N.,** *See* Morman, L.M., 12:36996
**Embrechts, M.J.,** *See* Steiner, D., 12:38377
**Emerson, D.T.,** *See* Tchernev, D.I., 12:37079
**Emery, K.A.,** Spectral mismatch correction for GaAs solar cells with varying junction depths, 12:36643 (J;GB)
**Emin, D.,** Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides, 12:37304 (R;US)
**Emmel, T.E.,** *See* Jones, J.W., 12:36761
**Emslander, H.L.,** *See* Hewett, M.J., 12:37041, 12:37042
**Endoh, Y.,** *See* Shirane, G., 12:37249
**Endrulat, H.J.,** *See* Winkelmann, I., 12:37710
**Engelke, K.,** *See* Dix, W.R., 12:37875
**Englander, S.L.,** *See* Dutt, G.S., 12:37035
**English, S.L.,** *See* Figuli, S., 12:36529
**Enrique, S.B.,** *See* Miguel, M.V., 12:36886
**Ensor, D.S.,** *See* Lawless, P.A., 12:37652
**Eppley, K.R.,** Design of a wiggler-focused, sheet beam X band klystron, 12:37557 (R;US)
**Epstein, M.M.,** *See* Gaines, G.B., 12:37367

**Erdin, K.,** Remote detection in forestry industry and the determination of damage from flue gases by aerial infrared thermography, 12:37776 (RA;DE;In German)
**Erdmann, H.-D.,** Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation, 12:37164 (R;DE;In German)
**Ernst, P.L.,** *See* Dietzel, H.J., 12:36450
**Ertekin, T.,** *See* Sung, W., 12:36453
**Erwin, D.N.,** *See* Kiel, J.L., 12:38012
**Eschbach, E.J.,** *See* Kannberg, L.D., 12:36904
**Eskra, M.D.,** *See* Zagrodnik, J.P., 12:36946
**Eskridge, R.,** ROADWAY: a numerical model for predicting air pollutants near highways. User's guide. Final report, 12:37624 (R;US)
**Esplin, M.P.,** *See* Barowy, W.M., 12:38018
**Esterberg, E.,** End use loads in multifamily buildings: some preliminary findings, 12:37036 (RA;US)
**Eto, J.,** *See* Kahn, E., 12:37001
**Ettinger, G.,** *See* Bernard, M.J. III, 12:37016
**Ettlinger, K.,** Agricultural utilization of thermal waters - demonstration program. Pt. 2. Detailed scheme of the demonstration program 'Agricultural utilization of geothermal waters in Waltersdorf' and establishment of an individual investigation program. Final report, 12:37144 (R;DE;In German)
**Ettlinger, L.,** *See* Lay, R., 12:36926
**Evans, A.E.,** *See* Dowdy, E.J., 12:37572
**Evans, C.,** *See* Colmenares, C.A., 12:36603
**Evans, D.,** *See* Neville, J., 12:36698
**Evans, G.,** Gas-particle flow within a high temperature solar cavity receiver including radiation heat transfer, 12:36708 (J;US)
**Evans, R.D.,** An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)
**Evans, T.E.,** Enhanced particle flux control in a tokamak with a resonant helical divertor, 12:38380 (R;US)
**Evens, A.,** Development of a computerized multifamily audit: technical and implementation issues, 12:37037 (RA;US)
**Evrard, G.,** *See* Vassout, P., 12:38015
**Ewing, T.W.,** *See* Kristoff, F.T., 12:37837
**Ewy, R.T.,** Generation and analysis of stable excavation shapes under high rock stresses, 12:38044 (R;US)
**Eyler, R.L.,** *See* Johnson, E.K., 12:36347
**Eyman, L.D.,** DOE Hazardous Waste Remedial Actions Program: Annual report, FY 1986, 12:36959 (R;US)

## F

**Fackler, O.,** An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
**Fagerholm, N.-E.,** *See* Ghazanfari, A.-R., 12:36758
*See* Jaervinen, E., 12:37501
**Fagerson, M.,** *See* Shen, L., 12:37057
**Fajans, J.,** Measurements of amplification and phase shift (wave refractive index) in a free-electron laser, 12:37472 (R;US)
**Falade, G.K.,** Mathematical analysis of single-well tracer test, 12:36383 (R;US)
**Falco, M.,** *See* Beretta, A., 12:36645
**Falkner, S.,** *See* Aderholz, M., 12:37565
**Fallowfield, H.J.,** Algal biomass from farm waste. A pilot plant study, 12:36628 (R;GB)
**Fam, A.T.,** Optimal partitioning and redundancy removal in computing partial sums. Technical report (Final) December 1985-January 1987, 12:38405 (R;US)
**Fang, J.,** *See* Sweet, D.V., 12:38005
**Fang, Ming Ming,** Annihilation of vortex-antivortex pairs in a superconducting shield, 12:37458 (R;US)
**Fanger, H.U.,** Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**Fantoni, R.,** *See* Borsella, E., 12:37481
**Farmer, J.R.,** VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)
**Farrington, G.C.,** *See* Hammetter, W.F., 12:37008
**Farrington, R.B.,** Comparison of analytical and experimental immersed, collector-side heat exchanger results, 12:36693 (BA;US)
Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank, 12:36689 (BA;US)
**Fasching, G.E.,** *See* Maloney, D.J., 12:36359
**Fasching, G.R.,** Ash deposition sensor development, 12:36356 (RA;US)
**Fassbender, A.,** *See* Molton, P., 12:36589
**Fassett, J.D.,** *See* Inn, K.G.W., 12:37577
**Fassnacht, G.F.,** *See* Kline, W.H., 12:37436
**Fathy, D.,** *See* White, C.W., 12:37332
**Fauth, D.J.,** *See* Hedges, S.W., 12:36760
**Federer, C.A.,** Red spruce diameter growth and Weibull functions for even-aged stand development, 12:37735 (RA;US)
*See* Hornbeck, J.W., 12:37737
**Fee, D.C.,** Monolithic fuel cells, 12:37010 (R;US)
**Feher, J.S.,** Ninth EPRI Member Utility Survey results, 12:36997 (R;US)
**Fehlau, P.E.,** New portable hand-held radiation instruments for measurements and monitoring, 12:36561 (R;US)
*See* Coop, K.L., 12:36562
**Feibus, H.,** Applications of separations technology for the control of pollutants in advanced coal combustion systems, 12:36336 (BA;US)
**Feldman, D.,** A research program in theoretical high-energy physics: Progress report, 12:38158 (R;US)
**Feldman, E.E.,** *See* Chang, L.K., 12:36933
**Feldman, G.,** *See* Kicinska-Habior, M., 12:38244
**Feldman, M.J.,** SIS (superconductor-insulator-superconductor) mixer research. Final report, 15 November 1985-14 November 1986, 12:37452 (R;US)
**Felst, R.,** *See* Bartel, W., 12:38117
**Felten, V.,** Application of airborne digital multispectral scanner data and testing of spaceborne data for the evaluation of forest degradation, 12:37773 (RA;DE)
*See* Marechal, P., 12:37774
**Fenner, H.,** *See* Behrend, H.J., 12:38116
**Fenske, G.R.,** *See* Kaufherr, N., 12:37286
**Fent, J.,** *See* Aderholz, M., 12:37565
**Fiandt, J.T.,** *See* Spehar, R.L., 12:37997
**Field, J.H.,** *See* Behrend, H.J., 12:38116
**Field, R.D.,** Perturbative QCD: K-factors, 12:38220 (RA;US)
**Fields, D.J.,** *See* Bougault, R., 12:38254
**Figley, D.A.,** Calculated and measured energy consumption for low energy houses, 12:37038 (RA;US)
**Figuli, S.,** Geologic software for nuclear waste repository studies: A quality assurance program, 12:36529 (R;US)
**Filion, L.,** Spatial distribution of light-ring years in subarctic Quebec, 12:37741 (RA;US)
*See* Begin, C., 12:38023
*See* Delwaide, A., 12:38029
**Fillo, J.P.,** *See* Gray, R.H., 12:36367
**Finch, C.B.,** *See* Shinn, M.D., 12:37474
**Finch, G.L.,** Beryllium particle density measurements using isopycnic density gradient centrifugation, 12:37617 (RA;US)
Cytotoxicity of beryllium compounds to cultured canine alveolar macrophages, 12:37972 (RA;US)
In vitro dissolution studies of beryllium aerosols, 12:37403 (RA;US)
Toxicokinetics of beryllium following acute inhalation of BeO by beagle dogs: a status report, 12:37965 (RA;US)
*See* Cuddihy, R.G., 12:36832
*See* Eidson, A.F., 12:37404
*See* Harmsen, A.G., 12:37973
*See* Hoover, M.D., 12:37615, 12:37616
**Fincher, R.W.,** *See* Parsons, R.S., 12:36408
**Findley, J.E.,** *See* O'Hara, J.B., 12:36241
**Finlay, R.W.,** *See* Mellema, S., 12:38246
**Finn, J.M.,** Anomalous current penetration and oscillating current drive in tokamaks, 12:38359 (J;US)
**Fiore, C.,** *See* Greenwald, M., 12:38326
**Fischer, A.K.,** Tritons and tritides as the solute and diffusing species in ceramic tritium breeders, 12:38370 (R;US)
**Fischer, J.E.,** *See* Shirane, G., 12:37249
**Fischer, J.P.,** Nasal metabolism of benzo[a]pyrene and dihydrosafrole in Beagle dogs and nonhuman primates, 12:37979 (RA;US)
**Fischer, K.,** *See* Wolf, L., 12:36888
**Fischer, M.,** *See* Kanzleiter, T., 12:36902
**Fischi, R.,** *See* Anand, D.K., 12:36700
*See* Helferty, J.J., 12:36717
**Fish, D.,** *See* Katrakis, J., 12:37044
**Fisher, A.T.,** *See* Bentley, J., 12:37290
**Fisher, D.C.,** *See* Muscatello, A.C., 12:36490
**Fisher, P.W.,** *See* Schuresko, D.D., 12:38372

**Fisher, R.A.,** Magnetic susceptibility of AuFe: T/sub g/ and Curie-Weiss parameters, 12:37226 (R;US)
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)
Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure, 12:37228 (R;US)
**Fisk, E.,** *See* Diebold, R., 12:37536
**Fisk, W.J.,** The impacts of balanced and exhaust mechanical ventilation on indoor radon, 12:37712 (R;US)
**Fisk, Z.,** *See* Arko, A.J., 12:37204
*See* Fisher, R.A., 12:37228
**Fitzgerald, S.,** *See* Eidson, A.F., 12:37404
**Flagg, C.N.,** *See* Behrens, W.J., 12:38049
**Flaherty, D.C.,** Mount St. Helens: the aftermath, 12:37673 (R;US)
**Flandermeyer, B.,** *See* Capone, D.W. II, 12:37287
*See* Ekin, J.W., 12:37288
**Flandermeyer, B.K.,** *See* Fee, D.C., 12:37010
**Flinn, D.R.,** *See* Carter, J.P., 12:37634
**Flora, D.,** *See* Piette, M.A., 12:37066
**Flores, F.,** Energy dissipation in the scanning tunneling microscopy of metals and insulators, 12:37276 (BA;US)
**Flores, J.A.,** Retrofit wall insulation study, 12:37039 (RA;US)
**Flouquet, J.,** *See* Fisher, R.A., 12:37227
**Flower, E.C.,** FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements, 12:37244 (R;US)
**Flueckiger, E.O.,** Correlation between asymptotic directions of cosmic-ray particles and cutoff rigidities in the evolving geomagnetic field, 12:38084 (R;US)
**Follansbee, P.S.,** High-strain-rate deformation mechanisms in copper and implications for behavior during shock-wave deformation, 12:37223 (R;US)
*See* Gray, G.T. III, 12:37221
**Follstaedt, D.M.,** Metastable phase boundaries of quasicrystalline phases, 12:37240 (R;US)
**Fontana, P.,** Optimizing heat distribution in continuous furnaces using a dynamic mathematical model, 12:37111 (RA;SE)
**Foord, M.,** *See* Greenwald, M., 12:38326
**Ford, R.E.,** *See* Meyer, O.R., 12:36920
**Ford, W.K.,** *See* Sahin, T., 12:36268
**Ford, W.T.,** Granlibakken meeting: b and c quark summary, 12:38187 (RA;US)
Physics from PEP, 12:38134 (RA;US)
**Fortune, C.R.,** *See* Cheney, J.L., 12:36333, 12:37656
**Foster, C.A.,** *See* Schuresko, D.D., 12:38372
**Foster, C.C.,** *See* Rapaport, J., 12:38241
**Foster, J.,** *See* Prindle, N.K., 12:37822
**Foster, M.,** Characterization of pore structure changes during gasification, 12:36288 (B;US)
**Fouasnon, S.,** *See* Winkelmann, I., 12:37710
**Fousek, R.J.,** *See* Fee, D.C., 12:37010
**Foust, C.R.,** *See* Schuresko, D.D., 12:38372
**Fow, C.L.,** Pilot-scale grout production test with a simulated low-level waste, 12:36527 (R;US)
**Fox, G.L.,** *See* Lovell, A.J., 12:36783
**Fox, J.L.,** Studies of infrared aurorae. Technical report, 12:38041 (R;US)
**Francis, G.,** *See* Fuchs, V., 12:38328
**Francis, J.E.,** *See* Creber, G.T., 12:38026
**Franco, C.,** Limits to process intensity in methane (biogas) generator systems, 12:36586 (R;GB)
**Franke, G.,** *See* Behrend, H.J., 12:38116
**Franke, R.,** *See* Vassout, P., 12:38015
**Franklin, A.L.,** The application of expert systems to the analysis of logic trees, 12:38016 (R;US)
**Franz, D.G.,** Development of an advanced gas-fired furnace for high-temperature heating of continuously cast thin-section steel products. Final report, January-December 1986, 12:36463 (R;US)
**Franzini, P.J.,** Toponium-$Z^0$ mixing, 12:38192 (RA;US)
**Fredrickson, E.,** *See* Hill, K.W., 12:38346
**Fredrickson, J.K.,** *See* Van Voris, P., 12:37816
**Fredrickson, S.E.,** *See* Anderson, M.S., 12:36390
**Freedman, J.M.,** Base technology development enhances state-of-the-art in meeting performance requirements, 12:37465 (R;US)
**Freedman, S.J.,** Search for short-lived axions emitted from neutron capture on protons, 12:38153 (BA;DE)
**Freese, J.M.,** *See* Magnani, N.J., 12:36944
**Freese, K.,** Cosmology with decaying vacuum energy, 12:38071 (J;NL)
**Freiesleben, H.,** *See* Sohlbach, H., 12:38260
**Freiser, H.,** Chelating extractants of improved selectivity: Final report, 12:37373 (R;US)
**Frey, J.S.,** *See* Ryan, M.A., 12:37356
**Frey, R.,** *See* Alexander J., 12:38168
**Fried, H.M.,** *See* Feldman, D., 12:38158
**Friedland, L.,** Congruent reduction and mode conversion in 4-dimensional plasmas, 12:38342 (R;US)
**Friedman, P.S.,** Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)
**Friedrich, L.,** *See* Bueche, G., 12:38231
**Frieman, J.A.,** *See* Freese, K., 12:38071
**Friley, J.R.,** *See* Alzheimer, J.M., 12:36778
**Frindik, O.,** *See* Diehl, J.F., 12:37817
**Fritts, H.C.,** Principles and practices of dendroecology, 12:37734 (RA;US)
**Froechtenicht, W.,** *See* Aderholz, M., 12:37565
**Froisland, L.J.,** *See* Dean, K.C., 12:37672
**Fryer, G.I.,** *See* Pruden, M.A., 12:37748
**Fthenakis, V.M.,** *See* Moskowitz, P.C., 12:36958
**Fu, C.Y.,** *See* Hetrick, D.M., 12:38274
**Fu, G.Y.,** *See* Demchenko, V.V., 12:38330
**Fu, Guoyong,** Effects of ballooning instability on tokamak confinement, 12:38329 (R;US)
**Fuchs, M.,** Transverse pusher induction heater for billets using medium frequency, 12:37121 (RA;SE)
**Fuchs, V.,** Fast-wave transmission and reflection in ion-cyclotron heating, 12:38328 (R;US)
**Fuentes, H.R.,** *See* Springer, E.P., 12:37850
**Fuerst, R.G.,** *See* Logan, T.J., 12:37651
**Fuerstenau, D.W.,** Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)
**Fuhrmann, M.,** *See* Dougherty, D.R., 12:36500
**Fujimoto, T.,** *See* Tsuge, A., 12:36917
**Fung, I.Y.,** *See* D'Arrigo, R., 12:37603
**Furinghetti, A., Pastorino, B.,** *See* Fontana, P., 12:37111
**Fuster, J.,** *See* Behrend, H.J., 12:38116

## G

**Gaarde, C.,** *See* Rapaport, J., 12:38241
**Gabioud, B.,** *See* de Teramond, G.F., 12:38201
**Gac, F.D.,** Whisker reinforced structural ceramics: Progress in the VLS growth and use of long silicon carbide whiskers, 12:37300 (R;US)
**Gadkari, S.C.,** A circuit for characterization of ferroelectrics, 12:37510 (R;IN)
**Gaget, J.,** *See* Chiche, P., 12:36276
**Gagnon, W.L.,** *See* Summers, M.A., 12:37487
**Gaines, G.B.,** Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**Gallacher, J.,** *See* Boshier, J.F., 12:36952
**Gallagher, J.S.,** Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report, 12:36725 (R;US)
**Gallardo, J.C.,** *See* Dattoli, G., 12:37476, 12:37477, 12:37478
**Gallegos, D.G.,** *See* Cheng, Y.S., 12:37613
**Gallerano, G.P.,** *See* Ciocci, F., 12:37480
**Gallup, D.,** *See* Marshall, A.C., 12:36789
**Galoff, P.K.,** *See* Sliney, D.H., 12:38011
**Gandy, R.,** *See* Greenwald, M., 12:38326
**Gangwar, A.,** *See* Kent, H.C., 12:36437
**Garcia, D.,** Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: an initial study, 12:37346 (R;US)
**Gardner, J.A.,** *See* Jaeger, H., 12:37320
**Gardner, M.,** *See* Yoder, R., 12:37060
**Gardner, R.H.,** *See* Bartell, S.M., 12:37833
**Garman, E.F.,** *See* Kicinska-Habior, M., 12:38244
**Garner, J.W.,** *See* Klett, R.D., 12:36533
**Garrad, A.D.,** Noise prediction programme for wind turbines, 12:36738 (R;GB)
**Garrett, B.A.,** *See* Smith, S.A., 12:37103
**Garrett, M.K.,** *See* Fallowfield, H.J., 12:36628
**Gartman, D.,** *See* Bogner, J., 12:37824
**Gary, S.P.,** *See* Tokar, R.L., 12:38364
**Gase, W.J.,** *See* Casleton, K.H., 12:36358
**Gasser, L.,** Implementing distributed AI systems using MACE, 12:38413 (BA;US)
**Gat, U.,** The ultimate safe (U.S.) reactor, 12:36934 (BA;US)
**Gates, D.M.,** Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)

**Gates, W.E.,** STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
**Gavaler, J.R.,** *See* Braginski, A.I., 12:37325
*See* Bragninski, A.I., 12:37448
**Gawlik, K.,** *See* Griffith, P., 12:36851
**Gaynor, A.J.,** New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Gazes, S.B.,** *See* Chan, Y., 12:38261
**Geacintov, N.E.,** *See* Yoshida, H., 12:38010
**Geballe, T.H.,** Superconducting thin films, composites & junctions. Annual report, 1 October 1985-30 September 1986, 12:37450 (R;US)
**Geisel, F.A.,** *See* Voelker, R.P., 12:36424
**Geiss, F.,** *See* Lindner, R., 12:37183
**Gelbke, C.K.,** *See* Bougault, R., 12:38254
**Gelies, F.O.,** Metal-glass facades with an integrated heating/cooling/ventilation system, 12:37076 (R;DE;In German)
**Gelinas, R.J.,** *See* Summers, M.A., 12:37487
**Gelmini, G.,** *See* Avignone, F.T. III, 12:38248
**Geng, C.Q.,** *See* Branco, G.C., 12:38211
**Genova, L.F.,** *See* Bulos, F., 12:37554
**Gentile, L.C.,** *See* Flueckiger, E.O., 12:38084
**Gentle, K.W.,** *See* Evans, T.E., 12:38380
**George, L.L.,** Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
**Georges, Ph.,** *See* Jouet, J., 12:37123
**Gerboth, D.M.,** *See* Gibson, M.W., 12:36532
**Gerlach, R.,** *See* Gillett, N.A., 12:37876
**Gerlach, R.F.,** Cross-sectional study of the effects of age on pulmonary function and lung morphology of Beagle dogs, 12:37887 (RA;US)
Effects of body position on pulmonary function of the F344/N rat, 12:37886 (RA;US)
*See* Muggenburg, B.A., 12:37924
**Gerrity, T.R.,** *See* Miller, F.J., 12:37996
**Gesewsky, P.,** *See* Winkelmann, I., 12:37710
**Gethers, F.E.,** *See* Schuresko, D.D., 12:38372
**Geyer, S.M.,** *See* Hoffman, J.S., 12:37635
**Ghazanfari, A.-R.,** Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Ghosh, A.K.,** *See* Gregory, E., 12:37255
**Gibbard, B.G.,** *See* Abe, K., 12:38115
*See* Ahrens, L.A., 12:38150
**Gibbons, J.J.,** *See* Simonson, J.M., 12:36948
**Gibson, C.H.,** *See* Ashurst, W.T., 12:38106
**Gibson, M.W.,** Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Gidaspow, D.,** *See* Lyczkowski, R.W., 12:36352
**Giel, T.V. Jr.,** In-situ particle characterization, 12:36307 (RA;US)
**Gieseke, J.A.,** STCP validation, 12:36909 (RA;US)
**Gifford, S.K.,** *See* Norris, A.E., 12:36520
**Giger, F.M.,** Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)
**Giguere, P.T.,** *See* Spore, J.W., 12:36867
**Gilat, J.,** *See* Toth, K.S., 12:38253
**Gilbert, E.R.,** *See* Levy, I.S., 12:36494
**Gilbert, J.,** *See* Boyack, B.E., 12:36863
**Gilbert, T.L.,** Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Gillett, N.A.,** Histopathology of secondary immune responses in the primate lung, 12:37884 (RA;US)
Mechanical and morphological evaluation of age-related changes in the Beagle spine, 12:37876 (RA;US)
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
*See* Boecker, B.B., 12:37913
*See* Gerlach, R.F., 12:37887
*See* Guilmette, R.A., 12:37927
*See* Hahn, F.F., 12:37908
*See* Harmsen, A.G., 12:37964
*See* Lundgren, D.L., 12:37926
*See* Mewhinney, J.A., 12:37918
*See* Muggenburg, B.A., 12:37921
**Gilman, F.J.,** Overview of the standard model, 12:38196 (R;US)
Phenomenology of heavy quark systems, 12:38129 (RA;US)
**Gilman, J.J.,** Enthusiasms and realities in advanced materials, 12:37196 (R;US)
**Ginley, D.S.,** *See* Schirber, J.E., 12:37305
**Ginocchio, J.N.,** Dynamical supersymmetric Dirac Hamiltonians, 12:38287 (BA;US)
**Ginsberg, T.,** Recent experimental and analytical results of BNL direct containment heating programs, 12:36911 (RA;US)
**Giot, P.,** *See* Felten, V., 12:37773
*See* Marechal, P., 12:37774
**Giovanola, J.H.,** Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)
**Gisler, G.R.,** *See* Baber, D.N., 12:38072
**Giuliani, P.,** *See* Chiche, P., 12:36276
**Givler, R.C.,** *See* Ortega, A., 12:36726
**Glaab, H.,** *See* Klug, W., 12:37598
**Glaeser, W.A.,** *See* Dufrane, K.F., 12:37167
**Glakpe, E.K.,** Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure, 12:36492 (R;US)
**Glanzman, T.,** Granlibakken report on the SSP Trigger, 12:37550 (RA;US)
**Glasser, L.A.,** *See* Penfield, P., 12:38402
**Glatz, J.P.,** *See* Lindner, R., 12:37183
**Glatzel, H.K.,** *See* Kicinska-Habior, M., 12:38244
**Glenn, L.A.,** Performance analysis of the two-stage light gas gun, 12:37468 (R;US)
**Glickstein, R.J.,** Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)
**Glish, G.L.,** *See* McLuckey, S.A., 12:37383
**Gloudemans, J.R.,** *See* Carter, H.R., 12:36844
**Glueer, C.C.,** *See* Dix, W.R., 12:37875
**Gochin, M.,** Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**Godbey, F.W.,** *See* Sheehy, J.W., 12:37685
**Godett, T.M.,** *See* Ziph, B., 12:36658
**Goemer, D.,** *See* Klug, W., 12:37598
**Goertz, C.K.,** *See* Gurnett, D.A., 12:38343
**Goldberger, M.L.,** Topics in arms control, 12:37187 (RA;US)
**Golden, D.W.,** Update on standard problem, data base, and uncertainties, 12:36897 (RA;US)
**Goldman, C.A.,** *See* Busch, J.F., 12:37031
*See* Greely, K.M., 12:37040
**Goldman, M.I.,** Energy policy in the USSR, 12:36982 (RA;SE)
**Goldstein, M.,** 3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)
**Goldston, R.J.,** Energy confinement and profile consistency in TFTR, 12:38351 (R;US)
**Goldwire, H.C. Jr.,** *See* Martins, S., 12:36438
**Golovato, S.N.,** *See* Myer, R.C., 12:38327
**Golub, L.,** Normal incidence x-ray telescope. Semiannual progress report, 1 May 1985-31 October 1986, 12:37566 (R;US)
**Gomez, C.,** *See* Greenwald, M., 12:38326
**Gonis, A.,** *See* Turchi, P.E.A., 12:37245
**Good, D.J.,** *See* Pickrell, J.A., 12:37971
**Goodman, B.,** *See* Brosch, G., 12:37099
**Goodman, C.D.,** *See* Rapaport, J., 12:38241
**Goodman, M.M.,** *See* Knapp, F.F. Jr., 12:37878
**Goodrich, R.W.,** *See* Hoogendyk, C.G., 12:37600
**Goodwin, G.M.,** *See* Swindeman, R.W., 12:36755
**Goodwin, S.,** Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi, 12:36604 (J;US)
**Googin, J.M.,** *See* Compere, A.L., 12:36605
**Goossens, R.,** *See* Roover, B. de, 12:37731
**Gorbinet, G.,** Study of fog formation and developments on the industrial plants at Lacq (France). Role of condensation nuclei, 12:37608 (R;FR;In French)
**Gordon, B.M.,** The application of a synchrotron radiation microprobe to trace element analysis, 12:37873 (R;US)
**Goretta, K.C.,** Deformation of polycrystalline $Li_2O$, 12:37306 (J;NL)
**Gorham-Bergeron, E.,** Confined volume blasting experiments: Description and analysis, 12:36466 (R;US)
**Gossett, C.A.,** *See* Kicinska-Habior, M., 12:38244
**Gottschalk, T.,** *See* Barger, V., 12:38207
**Gottula, R.C.,** *See* Dallman, R.J., 12:36919
**Gottwald, M.,** *See* Haberl, F., 12:38073
**Gouge, M.J.,** *See* Schuresko, D.D., 12:38372
**Goulding, C.A.,** *See* Dowdy, E.J., 12:37572
*See* Rapaport, J., 12:38241
**Govada, A.,** *See* Clark, A.V. Jr., 12:37264
**Grabowski, K.S.,** *See* King, W.E., 12:37203
**Graczyk, D.G.,** Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project, 12:36782 (R;US)
**Grady, D.E.,** A strain-rate-dependent spall mechanism transition in metals, 12:37242 (R;US)
**Graeff, W.,** *See* Dix, W.R., 12:37875
**Graeffe, G.,** *See* Keskinen, J., 12:37089
**Graese, A.M.,** *See* Kempton, J.P., 12:37562

**Graham, F.R.,** *See* Holt, D.L., 12:36487
**Graham, J.A.,** *See* Hatch, G.E., 12:37993
**Graham, R.A.,** *See* Venturini, E.L., 12:37348
**Graham, R.C.,** *See* Miller, F.J., 12:37996
**Graham, R.H.,** The evolution of interior intrusion detection technology at Sandia National Laboratories, 12:36566 (R;US)
**Granato, F.,** *See* Petrucci, M., 12:37215
**Grandvallet, P.,** Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1, 12:36598 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2, 12:36599 (R;FR;In French)
**Granetz, R.,** *See* Greenwald, M., 12:38326
**Granichi, S.,** Solar thermal central receiver power - A viable option for the 1990's, 12:36674 (BA;US)
**Granoff, B.,** *See* Stohl, F.V., 12:36600
**Gransell, H.,** Conditions for solar district heating. Market analysis, 12:36680 (R;SE;In Swedish)
**Grant, J.A.,** *See* Bulos, F., 12:37554
**Grant, M.,** *See* Piper, S., 12:37726
**Grant, M.W.,** *See* Cook, J.R., 12:36514, 12:36549
**Gras Marti, A.,** Tunneling from a self-energy approach, 12:37277 (BA;US)
**Graumlich, L.J.,** Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)
**Graves, K.K.,** *See* Pechan, E.H., 12:36764
**Graves, R.L.,** Testing of developmental ceramic materials in diesel engine combustion chambers, 12:37160 (R;US)
**Graves, R.S.,** *See* McElroy, D.L., 12:37023
**Gray, G.T. III,** Influence of peak pressure on the substructure evolution and mechanical properties of shock-loaded 6061-T6 aluminum, 12:37221 (R;US)
**Gray, H.A.,** Control of atmospheric fine primary carbon particle concentrations. Final report, 12:37654 (R;US)
**Gray, J.H.,** Recovery of transuranics from process residues, 12:36513 (R;US)
**Gray, J.R.,** Statistically stable branch method for improving accountability and control, 12:36573 (R;US)
**Gray, L.W.,** *See* Gray, J.H., 12:36513
**Gray, R.H.,** Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
**Gray, T.A.,** Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Graybill, D.A.,** Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
**Greely, K.M.,** Analyzing energy conservation retrofits in public housing: savings, cost-effectiveness, and policy implications, 12:37040 (RA;US)
**Green, D.,** Accurate 2 dimensional drift tube readout using time division and vernier pads, 12:37571 (J;NL)
**Green, T.A.,** *See* Emin, D., 12:37304
**Greene, G.A.,** Thermal-hydraulic studies on molten core-concrete interactions, 12:36903 (RA;US)
**Greenfield, C.M.,** *See* Ribe, F.L., 12:38336
**Greenholt, C.J.,** *See* Weirick, L.J., 12:36676
**Greenwald, M.,** Studies of the regime of improved particle and energy confinement following pellet injection into Alcator C, 12:38326 (R;US)
**Greenwood, L.R.,** *See* Smith, D.L., 12:38233
**Gregory, E.,** Importance of spacing in the development of high current densities in multifilamentary superconductors, 12:37255 (J;GB)
**Gregory, J.C.,** Space radiation studies. Annual report, November 1985-November 1986, 12:37567 (R;US)
**Gregory, J.J.,** Thermal measurements in large pool fires, 12:37462 (R;US)
**Greif, R.,** *See* Evans, G., 12:36708
**Griffin, F.P.,** Evaluation of power control methods for free-piston Stirling engine driven heat pumps, 12:37025 (R;US)
**Griffith, P.,** Dryout front modeling for rod bundles, 12:36852 (RA;US)
Two-phase flow measurement in the upper plenum of a PWR during reflood, 12:36851 (RA;US)
*See* Paik, C.Y., 12:36853
**Griffith, W.C.,** *See* Gillett, N.A., 12:37910
*See* Lundgren, D.L., 12:37925
*See* Medinsky, M.A., 12:37969
**Griffith, W.L.,** *See* Compere, A.L., 12:36605
**Grindley, T.,** High-temperature desulfurization of coal gas for gas turbine and fuel cell application, 12:36259 (RA;US)
**Grisham, D.L.,** Monitor - The prelude to robotics, 12:38415 (BA;US)
**Grishin, V.G.,** Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)
**Groeger, A.W.,** *See* Bonoff, M.B., 12:37844
**Groenier, W.S.,** Consolidated Fuel Reprocessing Program: Progress report for period October 1 to December 31, 1986, 12:36488 (R;US)
**Groenqvist, S.,** *See* Torisson, T., 12:37705
**Grose, E.C.,** *See* Massaro, E.J., 12:38004
**Gross, F.,** CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
Electromagnetic studies in nuclei, 12:38234 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] project, 12:37529 (R;US)
*See* Chang, C.C., 12:38161
**Grossier, E.,** *See* Fuchs, M., 12:37121
**Grossmann, W.D.,** Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)
**Grothaus, K.R.,** *See* Magnani, N.J., 12:36944
**Gruen, D.M.,** *See* Pellin, M.J., 12:38296
**Grunder, H.A.,** The Continuous Electron Beam Accelerator Facility, 12:37532 (R;US)
**Grynblat, J.,** *See* Gransell, H., 12:36680
**Guenther, P.T.,** *See* Smith, D.L., 12:38233
**Guerrieri, D.,** *See* Wilkowski, G.M., 12:36804
**Guess, T.R.,** Kevlar/epoxy laminates: Mechanical response of as-fabricated and shock-loaded materials, 12:37350 (R;US)
**Guffey, F.D.,** Combined gas chromatography/mass spectrometric evaluation of selected isothermally produced shale oils, 12:36475 (R;US)
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**Guilmette, R.A.,** Biokinetics of $^{239}$Pu in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
Interactions of plutonium and americium with bone mineral, 12:37907 (RA;US)
Preventing the translocation of inhaled $^{241}$Am in dogs using continuously infused DTPA, 12:37930 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
*See* Lundgren, D.L., 12:37926
*See* Muggenburg, B.A., 12:37917, 12:37919, 12:37921
*See* Newton, G.J., 12:37716
*See* Seiler, F.A., 12:37714, 12:37715
**Guin, J.A.,** Configurational diffusion of coal macromolecules: Quarterly progress report, March 15, 1987 to June 15, 1987, 12:36317 (R;US)
*See* Curtis, C.W., 12:36281
**Guinan, M.W.,** Radiation effects limits on superconducting magnets: Data base for copper stabilizers, 12:37243 (R;US)
**Guisan, O.,** Characterization of evacuated collectors, arrays, and collection subsystems: A report of Task 6: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36703 (R;FR)
**Gulari, E.,** *See* Dun, J.W., 12:36595
**Gundlach, J.H.,** *See* Kicinska-Habior, M., 12:38244
**Gunter, B.J.,** Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
**Guppy, J.G.,** *See* Cheng, H.S., 12:36811
**Gupta, A.K.,** Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)
**Guralnik, G.S.,** Research program in computational physics: [Progress report for Task D], 12:38159 (R;US)
**Gurdal, Z.,** *See* Pindera, M.J., 12:37329
**Gurnett, D.A.,** Plasma physics abstracts, 1 January - 31 December, 1986, 12:38343 (R;US)

**Gutwald, R.,** Tactical encirclement reductions, 12:37589 (R;US)
**Guven, H.M.,** Optimization of parabolic trough collector design for developing country applications using a closed-form expression for intercept factor, 12:36718 (BA;US)
**Guyette, R.,** Potential in using elemental concentrations in radial increments of old growth eastern red cedar to examine the chemical history of the environment, 12:38035 (RA;US)
**Guzman, J.,** *See* Kent, H.C., 12:36437
**Gwinn, D.,** *See* Greenwald, M., 12:38326

## H

**Haan, B.J. de,** *See* Klug, W., 12:37598
**Haas, G.,** *See* Evans, T.E., 12:38380
**Haase, C.S.,** Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 12:36523 (R;US)
*See* King, H.L., 12:38039
**Habegger, L.J.,** Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**Habel, R.,** *See* Conti, M., 12:37573
**Haberl, F.,** EXOSAT observations of double-peaked bursts with radius expansion from 4U/MXB 1820-30, 12:38073 (J;US)
**Hackmann, J.,** *See* Stefanov, B., 12:38354
**Hadeishi, T.,** Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
**Haefner, W.,** *See* Wolf, L., 12:36888
**Hagaman, E.W.,** *See* Chambers, R.R. Jr., 12:36297
**Hagen, E.W.,** *See* Minarick, J.W., 12:36921, 12:36922
**Hagen, W.F.,** *See* Manes, K.R., 12:37486
**Haggerty, H.,** *See* Green, D., 12:37571
**Hahan, F.F.,** *See* Mewhinney, J.A., 12:37918
**Hahn, A.A.,** *See* Moe, M.K., 12:38249
**Hahn, F.F.,** Effect of irradiation on unscheduled DNA synthesis induced by 4-nitroquinoline in tracheal epithelium of rats, 12:37929 (RA;US)
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII, 12:37912 (RA;US)
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)
*See* Boecker, B.B., 12:37913, 12:37914, 12:37916
*See* Cuddihy, R.G., 12:36832
*See* Diel, J.H., 12:37922
*See* Gillett, N.A., 12:37910
*See* Guilmette, R.A., 12:37920, 12:37927
*See* Lundgren, D.L., 12:37925, 12:37926
*See* Muggenburg, B.A., 12:37917, 12:37919, 12:37921
*See* Snipes, M.B., 12:37915
*See* Sun, J.D., 12:37974
**Haidt, D.,** *See* Bartel, W., 12:38117
**Halbach, K.,** *See* Attwood, D., 12:37559
**Halbert, M.L.,** Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
*See* Bertrand, F.E., 12:38263
**Hales, J.M.,** Wet scavenging processes, 12:37704 (R;US)
**Haley, P.J.,** Alterations of bronchoalveolar lavage cytology in cynomolgus monkeys after sequential saline lavages, 12:37869 (RA;US)
*See* Finch, G.L., 12:37965
**Hall, C.H.,** *See* Layton, D.W., 12:37584
**Hall, E.J.,** *See* Rossi, H.H., 12:37934
**Hall, F.,** SLAC site design aesthetics, 12:37534 (BA;US)
**Hallen, R.T.,** *See* Theander, O., 12:37406
**Halow, J.S.,** *See* Cicero, D.C., 12:36283
**Haltom, C.P.,** *See* Bentley, J., 12:37290
**Halzen, F.,** Discovery of very high energy point sources, 12:38069 (RA;US)
*See* Barger, V., 12:38207
**Hamersma, P.J.,** Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
**Hamm, R.R.,** *See* Murdock, S.H., 12:36544
**Hammel, J.E.,** High density Z pinch formed from a solid deuterium fiber, 12:38340 (R;US)
**Hammermaier, A.,** Comparative investigations of different measurement methods of Radiochromatograms for the evaluation of the radiochemical purity of ten radiopharmaceuticals, 12:37438 (R;DE;In German)
Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis, 12:37439 (R;DE;In German)
**Hammetter, W.F.,** Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**Hammons, B.E.,** *See* Zipperian, T.E., 12:37517
**Han, J.T.,** RCS natural circulation in a PWR station blackout accident--an application of NRC mechanistic codes, 12:36906 (RA;US)
**Han, S.M.,** Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries, 12:37358 (J;US)
**Hancock, J.S.,** *See* Duda, J.R., 12:36442
**Handke, J.,** *See* McManus, K.P., 12:37680
**Haney, L.N.,** *See* Meyer, O.R., 12:36920
**Hanford, J.,** *See* Palmiter, L., 12:37052
**Hanlon, L.L.,** *See* Guilmette, R.A., 12:37907
**Hansen, G.J.,** *See* Hansen, W.N., 12:37431
**Hansen, L.D.,** *See* Eatough, D.J., 12:36260, 12:37645
**Hansen, S.,** *See* Green, D., 12:37571
**Hansen, W.N.,** Absolute half-cell potential: A simple direct measurement, 12:37431 (J;US)
**Hanson, A.L.,** *See* Gordon, B.M., 12:37873
**Hanson, G.,** Finding open top, 12:38176 (RA;US)
**Hanson, R.G.,** *See* Odar, F., 12:36879
**Hanson, W.B.,** Retarding potential analyzer research. Semiannual report, 1 July-31 December 1986, 12:38087 (R;US)
**Harari, D.,** On the evolution of global strings in the early universe, 12:38057 (R;US)
The superstring, $DiffS^1/S^1$, and holomorphic geometry, 12:38217 (R;US)
**Harari, H.,** Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Hardman-Rhyne, K.A.,** Kinetic investigations of alkoxysilane sol-gel processing, 12:37312 (BA;US)
**Harima, Y.,** *See* Trubey, D.K., 12:38291
**Harkema, J.R.,** Acute effects of neutrophils on nasal epithelial mucosubstances: quantitative histochemistry, 12:37984 (RA;US)
*See* Bond, J.A., 12:37977
*See* Harmsen, A.G., 12:37983
*See* Kirkpatrick, D.T., 12:37975
*See* Sun, J.D., 12:37974
**Harling, O.K.,** Nuclear reactor and materials science research: Final technical report, May 1, 1985-September 30, 1986, 12:36819 (R;US)
**Harmon, A.,** *See* Chan, Y., 12:38261
**Harmon, B.D.,** *See* Anderson, G.L., 12:37011
**Harmon, B.N.,** Comment on"Realistic calculation of the indirect-exchange interaction in metals", 12:37250 (J;US)
**Harmsen, A.G.,** Biochemical and cellular changes in nasal lavages after intranasal instillation of endotoxin, 12:37983 (RA;US)
Lung cellular response and lymphocyte blastogenesis, 12:37973 (RA;US)
Translocation of particles by macrophages from lung to lymph nodes of rats, 12:37964 (RA;US)
*See* Finch, G.L., 12:37965, 12:37972
*See* Harkema, J.R., 12:37984
**Harrer, B.J.,** Lost conservation opportunities in the Pacific Northwest irrigation sector, 12:37148 (R;US)
**Harrie, J.,** *See* Roover, B. de, 12:37731
**Harrington, J.J.,** SIR-1: An autonomous mobile sentry robot, 12:36570 (R;US)
**Harrington, M.,** Documentation and user's manual for the Utility Cost Analysis Model. Final report, 12:36953 (R;US)
**Harris, J.D.,** *See* Minarick, J.W., 12:36921, 12:36922
**Harris, L.P.,** *See* Sundell, R.E., 12:37235
**Harrison, D.L.,** *See* DeBey, T.M., 12:36806
*See* DuCharme, A.R., 12:36929
**Harrison, J.,** *See* Duffy, C.J., 12:36541
**Hart, R.L.,** *See* Hicks, B.B., 12:37648
**Hart, W.D.,** *See* Meyers, R.A., 12:36286
**Hartel, R.W.,** Precipitation kinetics of the titanium isopropoxide hydrolysis reaction, 12:37310 (BA;US)
**Hartline, B.K.,** *See* Grunder, H.A., 12:37532
**Hartmann, A.,** Investigation of the structure of filter cakes from bore flushing, 12:36372 (RA;DE;In German)
Investigation of the structure of filter cakes from bore flushing. Investigation of temperature stability of bore flushing liquids based on water. Investigation of rock drilling processes with diamond cutters of peg shape, 12:36375 (R;DE;In German)
**Harvey, R.W.,** *See* Maskarinec, M.P., 12:37377

**Haschke, D.,** *See* Kanzleiter, T., 12:36902
**Haselkorn, R.,** Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**Hashemian, H.M.,** Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Haste, G.R.,** *See* Owens, T.L., 12:38371
**Hatch, G.E.,** Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)
*See* Massaro, E.J., 12:38004
**Hatfield, B.,** *See* Bernard, M.J. III, 12:37016
**Hatfield, B.K.,** *See* Collins, N.E., 12:37017
**Hattrup, M.P.,** 1985 primary heating fuel use and switching: Assessment of the market for conservation in the Northwest: Phase 2, 12:37080 (R;US)
*See* Harrer, B.J., 12:37148
**Haubelt, R.,** *See* Winkelmann, I., 12:37710
**Haugstad, A.,** *See* Hirsch, R.v., 12:36609
**Hauser, D.,** Investigations at the Welding Institute, 12:37237 (RA;US)
**Hauserman, W.B.,** Slurry valve development, 12:36246 (RA;US)
**Hautanen, J.,** *See* Keskinen, J., 12:37089
**Havlik, M.E.,** Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**Hawley, C.C.,** *See* Retherford, R.M., 12:36365
**Hawley-Fedder, R.,** *See* Leider, H.R., 12:37381
**Haxton, W.C.,** Nuclear structure problems in double beta decay, 12:38290 (BA;US)
**Hayatsu, R.,** Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin, 12:36294 (R;US)
**Hayes, K.,** Study of $D^+ \rightarrow K^- \pi^+ \pi^+$ selection using the vertex drift chamber, 12:38188 (RA;US)
**Haygarth, J.C.,** *See* Jaeger, H., 12:37320
**Haynes, H.W. Jr.,** Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
**Hazucha, M.,** *See* Horstman, D., 12:37994
**Hecht, S.L.,** *See* Lovell, A.J., 12:36783
**Hedges, S.W.,** Properties of CuO sorbents related to $SO_2$ reactivity, 12:36760 (R;US)
**Hedin, E.R.,** *See* Ribe, F.L., 12:38336
**Hedman, H.,** *See* Gransell, H., 12:36680
**Hedstrom, J.,** *See* Boyack, B.E., 12:36863
**Hefting, T.,** *See* Smeers, Y., 12:36435
**Hegg, D.A.,** Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**Heiberger, J.J.,** *See* Fee, D.C., 12:37010
**Heifetz, D.B.,** Vectorizing and macrotasking Monte Carlo neutral particle algorithms, 12:38352 (R;US)
**Heimbichner, R.,** *See* Glickstein, R.J., 12:36969
**Heineman, M.C.,** *See* Nadel, S.M., 12:37046
**Heinicke, P.,** A multiple node software development environment, 12:38410 (R;US)
**Heiple, C.R.,** Acoustic emission produced by deformation of metals and alloys, 12:37233 (R;US)
Origin of trace element effects on GTA weld pool shape, 12:37234 (RA;US)
**Heist, J.A.,** *See* Barron, T.S., 12:37143
**Heitbrink, W.,** In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)
**Heitbrink, W.A.,** Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
**Helfand, D.J.,** Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986, 12:38050 (R;US)
**Helferty, J.,** *See* Anand, D.K., 12:36700
**Helferty, J.J.,** On the selection of distributed parameter models for control studies of solar energy systems, 12:36717 (BA;US)
**Helffrich, J.A.,** *See* Bowles, T.J., 12:38152
*See* Knapp, D.A., 12:38236
**Hellegouarc'h, J.,** *See* Jouet, J., 12:37123
**Heller, J.P.,** Critical review of the foam rheology literature, 12:37415 (J;US)
**Hellman, B.,** Modernization of soaking pit furnaces with the aim of achieving lower energy consumption, 12:37120 (RA;SE)
**Hellstrom, E.E.,** *See* Hammetter, W.F., 12:37008
**Helmijoki, A.,** *See* Keskinen, J., 12:37089
**Helt, J.E.,** Production and characterization of pyrolysis liquids from municipal solid waste, 12:37855 (R;US)
Pyrolysis of municipal solid waste, 12:37154 (R;US)
**Hemling, M.E.,** *See* Krumholz, L.R., 12:38009
**Hemphill, R.C.,** The death spiral: An assessment of its likelihood in electric utilities, 12:36993 (R;US)
**Henderson, R.F.,** Rapid method for determining soot content of lungs in diesel-exposed rodents, 12:37966 (RA;US)
*See* Harmsen, A.G., 12:37983
*See* Kirkpatrick, D.T., 12:37975, 12:37982
*See* Mauderly, J.L., 12:36476
*See* Pickrell, J.A., 12:37971
*See* Sun, J.D., 12:37974
**Henderson, T.R.,** *See* Yeh, H.C., 12:37619
**Hendriks, R.V.,** *See* Kirchgessner, D.A., 12:37670
**Henninger, R.J.,** MELPROG/TRAC: update and applications, 12:36907 (RA;US)
*See* Spore, J.W., 12:36867
**Henrie, J.O.,** Lessons learned from hydrogen generation and burning during the TMI-2 event, 12:36829 (R;US)
**Henry, E.A.,** *See* Meyer, R.A., 12:38256
**Henschel, D.B.,** Some results from the demonstration of indoor radon reduction measures in block basement houses. Report for June 1985-February 1987, 12:37720 (R;US)
*See* Dunn, J.E., 12:37717
**Hensel, J.P.,** Fiber optic instrumentation development, 12:36305 (RA;US)
**Hensel, P.J.,** *See* Romanosky, R.R. Jr., 12:36309
**Hensley, D.C.,** *See* Halbert, M.L., 12:38251
**Heper, H.,** *See* Almenas, K., 12:36846
**Herakovich, C.T.,** *See* Pindera, M.J., 12:37329
**Herceg, J.E.,** *See* Schlenger, B.J., 12:36824
**Herczeg, P.,** Constraints on general SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models from nuclear beta decay, 12:38210 (BA;DE)
**Herczfeld, P.,** *See* Anand, D.K., 12:36700
**Herczfeld, P.R.,** *See* Helferty, J.J., 12:36717
**Herman, N.,** *See* Gasser, L., 12:38413
**Herring, J.S.,** *See* Holland, D.F., 12:38378
**Herrmann, K.,** *See* Kritikos, G., 12:37781
**Herrmannsfeldt, W.B.,** *See* Eppley, K.R., 12:37557
**Herschman, H.R.,** *See* Schneider, C.A., 12:37880
**Hertel, E.S. Jr.,** *See* Klett, R.D., 12:36533
**Hertlein, R.J.,** *See* Weiss, P.A., 12:36862
**Heshmat, H.,** *See* Shapiro, W., 12:36253
**Hesselmann, K.,** Heating exchanger networks, an exergo-economic study, 12:37497 (R;DE;In German)
**Hetrick, D.M.,** Calculated neutron-induced cross sections for /sup 58,60/ Ni from 1 to 20 MeV and comparisons with experiments, 12:38274 (R;US)
**Hettwer, P.F.,** *See* Burrage, L.M., 12:36771
**Heusch, C.A.,** Search for new interactions via lepton flavor violation at or beyond the $Z^0$ pole., 12:38174 (RA;US)
**Hewett, A.,** Energy situation and politics in the USSR, 12:36983 (RA;SE)
**Hewett, D.W.,** Direct implicit electromagnetic plasma simulation, 12:38356 (R;US)
**Hewett, J.L.,** Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories, 12:38164 (R;US)
Radiative B decays with four generations, 12:38163 (R;US)
**Hewett, M.J.,** Heating cost allocation in centrally heated rental housing: energy conservation potential and standards issues, 12:37042 (RA;US)
Measured energy savings from vent dampers in low rise apartment buildings, 12:37041 (RA;US)
**Hewitt, D.C.,** *See* Schlegel, J.A., 12:37056
**Hewitt, G.F.,** *See* Black, P.S., 12:36881
**Hewitt, H.C. Jr.,** Flow measurement techniques in the evaluation of heat pump and fan performance, 12:36696 (BA;US)
**Hewlett, R.G.,** A history of the United States Atomic Energy Commission, 1952-1960: Volume 3, 12:37593 (R;US)
**Heyde, K.,** *See* Meyer, R.A., 12:38256
**Hibbs, M.,** *See* Baker, N.J., 12:38243
**Hickman, G.D.,** *See* Dycus, D.L., 12:37846
**Hicks, B.B.,** Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)
*See* McMillen, R.T., 12:37671
**Hicks, K.L.,** *See* Rockefeller, G.D., 12:36767
**Hicks, R.S.,** Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**Hidde, J.S.,** *See* Pindera, M.J., 12:37329

**Hiester, T.R.,** *See* Barnard, J.C., 12:36736
**Hilaire, L.,** *See* Lehn, J.M., 12:36576
**Hildebrandt, G.,** Pilot survey for a European inventory of forest decline, 12:37789 (RA;DE;In German)
**Hill, C.T.,** Broken symmetry and the accelerated observer, 12:38226 (BA;US)
Superconducting cosmic strings with massive fermions, 12:38225 (J;NL)
**Hill, D.D.,** *See* Kirkpatrick, A.T., 12:36695
*See* Mahajan, B.M., 12:36691
**Hill, K.W.,** Impurity and particle transport and control in TFTR, 12:38382 (R;US)
Tokamak physics studies using x-ray diagnostic methods, 12:38346 (R;US)
**Hilliard, R.K.,** *See* Muhlestein, L.D., 12:36899
**Hinchliffe, I.,** The standard model and colliders, 12:38218 (R;US)
**Hinderman, T.K.,** *See* Retherford, R.M., 12:36365
**Hippo, E.J.,** Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)
**Hirao, Y.,** *See* Tsuge, A., 12:36917
**Hirsch, R.v.,** Model with two reservoirs used in a multisystem model, 12:36609 (R;NO;In Norwegian)
**Hirschenhofer, J.H.,** *See* Peters, W.C., 12:37006
**Hirth, J.P.,** *See* Chatterjee, A., 12:37261
**Hlavinka, M.W.,** *See* Bullin, J.A., 12:37184
**Ho, P.,** *See* Coltrin, M.E., 12:37430
**Ho, P.C.,** A review of the organic geochemistry of shales, 12:36526 (R;US)
**Ho, Shu Kay,** An alpha loss-cone instability in the central cell of a tandem mirror reactor, 12:38325 (R;US)
**Hoagland, R.G.,** *See* Chatterjee, A., 12:37261
**Hobbs, C.H.,** *See* Hahn, F.F., 12:37908, 12:37911, 12:37912
*See* Rothenberg, S.J., 12:37618
*See* Yeh, H.C., 12:37619
**Hobbs, P.V.,** *See* Hegg, D.A., 12:37658
**Hockaday, M.Y.P.,** An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
**Hoefle, H.C.,** *See* Leuschner, H.H., 12:38025
**Hoegberg, E.,** Umea energy savings blocks quality controlled programs save up to 40% energy in houses built in the 70's, 12:37043 (RA;US)
**Hoel, L.A.,** Innovative financing for transportation: practical solutions and experiences. Final report, 12:37101 (R;US)
**Hoff, R.W.,** Beta decay of neutron-rich transuranic nuclei, 12:38264 (BA;DE)
**Hoffheins, B.S.,** *See* Lauf, R.J., 12:37378
**Hoffman, D.J.,** ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
*See* Swain, D.W., 12:38374
**Hoffman, J.S.,** Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**Hoffmann, E.M.,** *See* Conway, T., 12:37867
**Hoffmann, G.W.,** Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)
**Hoftun, J.S.,** *See* Ahrens, L.A., 12:38150
**Hoh, J.C.,** *See* Graczyk, D.G., 12:36782
**Hohenberg, C.M.,** *See* Hudson, G.B., 12:38070
**Hohrseiter, D.,** *See* Reisman, D.J., 12:37990
**Hojo, T.,** *See* Iguchi, T., 12:36858, 12:36859
*See* Murao, Y., 12:36861
**Holbert, K.E.,** *See* Hashemian, H.M., 12:36774
**Holcomb, E.E.,** *See* Dallman, R.J., 12:36919
**Holden, T.M.,** *See* Flower, E.C., 12:37244
**Holditch, S.A.,** The analysis of complex Travis Peak reservoirs in east Texas, 12:36441 (BA;US)
The GRI staged field experiment, 12:36440 (BA;US)
*See* Sullivan, R.B., 12:36455
*See* Whitehead, W.S., 12:36454
**Holl, J.M.,** *See* Hewlett, R.G., 12:37593
**Holland, D.F.,** Fusion Safety Program annual report: Fiscal year 1986, 12:38378 (R;US)
**Holland, O.W.,** *See* White, C.W., 12:37332
**Hollander, F.,** Accurate temperature control of the reheating process at mixed cold and hot charging, 12:37110 (RA;SE)
**Holler, Y.,** *See* Behrend, H.J., 12:38116
**Holman, R.,** Fate of the m/sub b//m/sub tau/ mass relation in superstring theories, 12:38202 (J;NL)
**Holmes, J.A.,** Nonlinear dynamics of tearing modes in the reversed field pinch, 12:38332 (R;US)
**Holmgren, B.,** Small scale aerial IR-photographs for inventory of forest damage - experiences from Swedish test areas, 12:37730 (RA;DE)
**Holmstroem, H.,** Finnish assessment of RELAP5/MOD2, 12:36875 (RA;US)
**Holt, D.,** Superinsulated houses: The importance of resale value, 12:37098 (BA;US)
**Holt, D.L.,** Comparison of laboratory and plant mixer-settlers, 12:36487 (R;US)
**Holten, M.L.,** Engineering Research Division publication report, Calendar year 1986, 12:37447 (R;US)
**Holton, G.A.,** *See* King, C.M., 12:37821
**Holtum, J.A.M.,** Carbon and carbon metabolism in the environment, 12:37905 (R;DE)
**Holtzworth, J.D.,** *See* Johnson, E.K., 12:36347
**Holupka, E.,** *See* Brinker, C.J., 12:37316
**Holve, D.J.,** *See* Natesan, K., 12:36232
**Holzrichtr, J.F.,** *See* Manes, K.R., 12:37486
**Homan, C.G.,** Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)
**Hong, Deog Ki,** *See* Harari, D., 12:38217
**Hong, M.,** *See* Ekin, J.W., 12:37288
**Honkanen, K.,** *See* Halbert, M.L., 12:38251
**Honquilada, Q.L.,** *See* Nakagawa, C.H., 12:36590
**Hoogendyk, C.G.,** Two-zone modelling for air exchange rates and $NO_2$ source and decay rates in a Southern California residential indoor air quality study, 12:37600 (R;US)
**Hooper, S.,** Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
**Hoover, M.D.,** Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys, 12:37615 (RA;US)
Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization, 12:37616 (RA;US)
*See* Eidson, A.F., 12:37404
*See* Finch, G.L., 12:37403, 12:37617, 12:37965, 12:37972
**Hor, P.H.,** Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)
**Horacek, D.R.,** Reduced girth seam weldments for heavy-walled vessels, 12:36249 (RA;US)
Reduced girth seam weldments for heavy-walled vessels and burst tubes, 12:37456 (RA;US)
**Horgan, D.,** *See* Morman, L.M., 12:36996
**Horie, Y.,** Modeling of shock-induced solid state chemistry, 12:38300 (R;US)
**Horn, D.,** *See* Bougault, R., 12:38254
**Horn, F.,** *See* Benenati, R., 12:36781
**Horn, F.L.,** Tests of candidate materials for particle bed reactors, 12:36780 (R;US)
*See* Lazareth, O.W., 12:36779
*See* Slovik, G., 12:36784
**Hornbeck, J.W.,** Extended growth decreases in New England are limited to red spruce and balsam fir, 12:37737 (RA;US)
*See* Federer, C.A., 12:37735
**Horne, C.P.,** IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0, 12:36814 (R;US)
**Horner, D.M.,** *See* Decker, A.D., 12:36446
*See* Logan, T.L., 12:36452
**Horowitz, S.H.,** Adaptive transmission system relaying, 12:36768 (R;US)
*See* Phadke, A.G., 12:36769
*See* Thorp, J.S., 12:37511
**Horstman, D.,** Airway sensitivity of asthmatics to sulfur dioxide, 12:37994 (R;US)
**Horton, E.L.,** *See* Schlenger, B.J., 12:36824
**Hosemann, P.,** *See* Kanzleiter, T., 12:36902
**Hotchkiss, J.,** *See* Harkema, J.R., 12:37984
**Hotchkiss, J.A.,** *See* Harmsen, A.G., 12:37983
**Houf, W.,** *See* Evans, G., 12:36708
**House, F.A.,** *See* Cutburth, R.W., 12:37471
**Hout, K.D. v.d.,** *See* Klug, W., 12:37598
**Howard, I.A.,** *See* Emin, D., 12:37304
**Howard, W.E.,** *See* Luffel, D.L., 12:36432
**Howe, R.E.,** *See* Bauer, R.W., 12:38247
**Howell, R.W.,** Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)
**Hsii, Y.G.,** *See* Sheron, B.W., 12:36839
**Hsiu, F.J.,** *See* Aiyar, G.S., 12:36512
**Hsu, D.K.,** *See* Rehbein, D.K., 12:37271
**Hsu, J.T.,** *See* Ishii, M., 12:36855

**Hsu, Jang-Yu,** Polarization change of electron cyclotron waves by reflection, 12:38337 (R;US)
**Hsu, Y.Y.,** *See* Almenas, K., 12:36846
*See* Lin, W.K., 12:36854
**Hsuan, H.,** *See* Hill, K.W., 12:38346
**Hu, W.,** Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987, 12:36237 (R;US)
**Huang, C.Y.,** *See* Hor, P.H., 12:37359
**Huang, Ching-Chung,** *See* Kono, Hisashi O., 12:36354
**Huang, J.,** *See* Akbari, H., 12:37029
**Huang, Y.J.,** [Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)
**Huang, Y.J.R.,** Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Huchler, S.,** *See* Tsertos, H., 12:38095
**Hudischewskyj, A.B.,** *See* Seigneur, C., 12:37643
**Hudson, G.B.,** The early solar system abundance of $^{244}$Pu as inferred from the St. Severin chondrite, 12:38070 (R;US)
**Huemann, M.,** *See* Elliott, L.J., 12:37631
**Huetten, H.,** Automobile engines. Design and function, 12:37163 (R;DE;In German)
**Huettenhoelscher, N.,** High-temperature solar kilns for brickmaking - a contribution towards thermodynamic design of a system for the utilization of solar process heat, 12:36686 (R;DE;In German)
**Huffman, R.L.,** *See* Hicks, R.S., 12:38240
**Hughes, R.C.,** Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors, 12:37519 (J;US)
**Hugrass, W.N.,** *See* Siemon, R.E., 12:38341
**Huhtinen, M.,** Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Hull, J.R.,** Microconvection effects at gradient zone boundaries, 12:36701 (R;US)
**Hulliger, F.,** *See* Crabtree, G.W., 12:37205
**Hummel, F.C.,** What does the wood customer expect from inventories of endangered forests, 12:37894 (RA;DE)
**Hung, L.,** *See* Cangelosi, G.A., 12:37865
**Hunsberger, S.,** *See* Medinsky, M.A., 12:37969
**Hunt, A.J.,** *See* Tewari, P.H., 12:37322
**Hunt, E.R.,** *See* Whitehead, W.S., 12:36454
**Hunt, J.E.,** *See* Kini, A.M., 12:37389
**Hunt, K.M.,** *See* Barron, T.S., 12:37143
**Hunter, C.W.,** *See* Weber, E.T., 12:36820
**Hunter, S.R.,** Evaluation of a digital optical ionizing radiation particle track detector, 12:37568 (R;US)
**Hupp, C.R.,** Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)
**Huppi, R.J.,** *See* Barowy, W.M., 12:38018
**Hurd, A.J.,** Particle compaction with alternating electric fields: The effects of electrode geometry, 12:37428 (BA;US)
**Hurtubise, R.J.,** Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)
**Huson, R.,** A primer on detectors in high luminosity environment, 12:37574 (BA;US)
**Hutber, F.W.,** Energy statistics and the planning perspective, 12:36979 (J;GB)
**Hutchinson, M.,** *See* Nelson, B.D., 12:37047
**Huvinen, T.,** Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
**Hvid, J.,** *See* Kofod, P., 12:36702
**Hwa, R.C.,** *See* Chen, W.R., 12:38200
**Hwang, C.C.,** Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 7, March 1, 1987-May 31, 1987, 12:36269 (R;US)
**Hwang, R.N.,** Considerations pertinent to the Doppler effect for space reactors, 12:36785 (R;US)
**Hylander, J.,** Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades, 12:36757 (R;SE)
**Hymas, C.R.,** *See* Fow, C.L., 12:36527

## I

**Iachello, F.,** Dynamic symmetries in scattering, 12:38316 (BA;US)
Mysterious world of symmetry in physics, 12:38315 (BA;US)
**Ibers, J.A.,** *See* Squattrito, P.J., 12:37257
**Iguchi, T.,** SCTF-III test plan and recent SCTF-III test result, 12:36859 (RA;US)
Summary of CCTF test results, 12:36858 (RA;US)
*See* Murao, Y., 12:36861
**Imamura, J.N.,** X-ray and ultraviolet radiation from accreting white dwarfs. IV. Two-temperature treatment with electron thermal conduction, 12:38074 (J;US)
**Inall, E.K.,** *See* Bilodeau, E.A., 12:36677
**Indusi, J.P.,** A safeguards risk approach to inspection scheduling, 12:36557 (R;US)
**Ingalls, R.L.,** X-ray spectroscopy of solids under pressure: Technical progress report, July 1984-April 1987, 12:37335 (R;US)
**Ingram, L.O.,** *See* Conway, T., 12:37867
**Inn, K.G.W.,** Development of the NBS $^{10}$Be/$^{9}$Be isotopic standard reference material, 12:37577 (R;US)
**Innes, W.,** Summary of work on $Z^0 \rightarrow$ Higgs anti ff, 12:38184 (RA;US)
**Insalaco, J.W.,** Comparison of results for ten analytical heat conduction problems as solved by the general heat transfer code HEATING5 [Heat Engineering and Transfer in Nine Geometries], 12:36498 (R;US)
**Irdi, G.A.,** An automated microscopic method for the determination of pyrite size distributions in crushed coal, 12:36298 (R;US)
**Isenhower, L.D.,** Search for gluonic bound states in high energy proton-proton collisions, 12:38154 (D;US)
**Ishii, M.,** Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
**Ito, Y.,** *See* Siemon, R.E., 12:38341
**Itten, K.I.,** *See* Meyer, P., 12:37778
*See* Mueller, E., 12:37782
**Iversen, T.,** Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation, 12:37621 (R;NO;In Norwegian)
**Ivey, D.L.,** *See* Hattrup, M.P., 12:37080
**Iwamura, T.,** Heat transfer enhancement in SCTF tests, 12:36860 (RA;US)
*See* Akimoto, H., 12:36887
*See* Iguchi, T., 12:36859
*See* Murao, Y., 12:36861
**Iyer, K.,** *See* Theofanous, T.G., 12:36857

## J

**Jaakkola, J.,** *See* Lindholm, M., 12:37083
**Jabs, H.,** *See* Dix, W.R., 12:37875
**Jaccard, D.,** *See* Fisher, R.A., 12:37227
**Jackson, A.,** The magnet lattice of the LBL 1-2 GeV Synchrotron Radiation Source, 12:37561 (R;US)
**Jackson, G.L.,** *See* Evans, T.E., 12:38380
**Jackson, J.O.,** *See* Schwope, A.D., 12:37449, 12:37451
**Jackson, R.J.,** *See* Wood, D.H., 12:37232
**Jacoby, G.C.,** *See* D'Arrigo, R., 12:37603
*See* Sheppard, P.R., 12:37752
*See* Telewski, F.W., 12:37764
**Jacques, I.D.,** UNC environmental surveillance report for the 100 areas: FY 1985, 12:36816 (R;US)
UNC environmental surveillance report for the 100 areas: FY 1986, 12:36817 (R;US)
**Jacquin, Y.,** *See* Chiche, P., 12:36276
**Jadach, S.T.,** Renormalization group improved Yennie-Frautschi-Suura Theory and Monte Carlo event generators, 12:38169 (RA;US)
**Jaeger, E.F.,** *See* Batchelor, D.B., 12:38321
**Jaeger, H.,** Zirconia characterization by perturbed angular correlation spectroscopy, 12:37320 (BA;US)
**Jaemsae, S.,** Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)
**Jaervinen, E.,** Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
**Jaffe, R.L.,** Compositeness below 1 TeV, 12:38194 (RA;US)
**Jahkola, A.,** *See* Huhtinen, M., 12:36363
**Jain, S.C.,** *See* Cicero, D.C., 12:36283
**James, S.C.,** Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)
**Janis, W.J.,** *See* Bonzon, L.L., 12:36918
**Janka, K.,** *See* Keskinen, J., 12:37089
**Janney, M.A.,** *See* Shaffer, P.T.B., 12:37282
**Janocko, M.A.,** *See* Ekin, J.W., 12:37288

**Jansen, P.,** *See* Berggreen Petersen, M., 12:37156
**Jantunen, M.,** *See* Pellikka, M., 12:37085, 12:37090
**Jarl, M.,** Oxide scale formation on steel in fuel fired reheating furnaces, 12:37214 (RA;SE)
**Jaroszewicz, T.,** *See* Bleszynski, M., 12:38289
**Jauch, U.,** Porosity and thermal shock behaviour of ceramic materials, 12:37299 (R;DE;In German)
**Jeffers, J.N.R.,** Is ecosystem theory a basis for the inventory and monitoring of endangered forest, 12:37770 (RA;DE)
**Jeffrey, A.W.A.,** Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Jeffrey, R.G.,** Mechanical interactions in branched or subparallel hydraulic fractures, 12:36398 (BA;US)
*See* Thiercelin, M., 12:36394
**Jelonek, M.P.,** Frequency-shift measurements of the Q(1) and Q(2) lines of $H_2$ using high-resolution c-w Coherent Anti-Stokes Raman Spectroscopy. Master's thesis, June-October 1986, 12:38092 (R;US)
**Jenks, R.P.,** *See* Spore, J.W., 12:36867
**Jensen, D.A.,** *See* Sullivan, M.W., 12:38151
**Jensen, K.F.,** *See* Foster, M., 12:36288
**Jensen, M.T.,** Construction and testing of a Darrieus wind turbine. Demonstration plant, 12:36741 (R;DK;In Danish)
**Jensen, S.A.,** Measurements of power quality for a modern wind turbine, 12:36743 (R;DK;In Danish)
**Jervered, B.,** Experiences of computer control of heating processes at Avesta Jernverk, 12:37109 (RA;SE)
**Jevicki, A.,** *See* Feldman, D., 12:38158
**Jeziorski, B.,** *See* Fackler, O., 12:38198
**Jih, J.H.,** *See* Voet, D., 12:37861
**Jiles, D.C.,** Investigation of the microstructural dependence of the magnetic properties of 4130 alloy steels and carbon steels for NDE, 12:37269 (BA;US)
**Jobe, R.K.,** *See* Thompson, K.A., 12:37556
**Joerges, B.,** Energy conservation between environmental policy and consumer policy. Experience from eight countries, 12:37070 (R;DE;In German)
**Johansson, B.,** *See* Gransell, H., 12:36680
**Johansson, M.,** Switching-off power loads in industry, 12:36998 (R;DK;In Danish)
**John, P.W.,** Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
**John, W.,** Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
**Johnson, A.B. Jr.,** *See* Levy, I.S., 12:36494
**Johnson, A.R.,** *See* Boston, H.L., 12:37838
**Johnson, C.E.,** *See* Fischer, A.K., 12:38370
**Johnson, D.,** *See* Diebold, R., 12:37536
**Johnson, D.E.,** *See* Kristoff, F.T., 12:37837
**Johnson, D.G.,** *See* Wasielewski, M.R., 12:36622, 12:36623
**Johnson, D.H.,** *See* Castellano, C.C., 12:36679
**Johnson, D.O.,** *See* Coerr, S., 12:37682
**Johnson, E.A.,** Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
*See* Pruden, M.A., 12:37748
**Johnson, E.K.,** Reduction of erosion in elbows due to flow field modifications, 12:36347 (RA;US)
**Johnson, G.W.,** *See* Martins, S., 12:36438
*See* Weaver, W.L. III, 12:36865
**Johnson, J.A.,** *See* Carlson, N.M., 12:37270
**Johnson, J.N.,** Hot-spot reaction in unsustained shocks, 12:37582 (R;US)
**Johnson, L.,** *See* Millar, M., 12:36416
**Johnson, M.,** Power plant report, monthly cumulative for 1987 (EIA-759). Data file, 12:36999 (R;US)
**Johnson, R.,** *See* Delnon, R.J., 12:36739
*See* Thompson, K.A., 12:37556
**Johnson, R.N.,** *See* Natesan, K., 12:37209
**Johnson, T.R.,** *See* Cetegen, B.M., 12:36765
**Johnsson, B.,** Fuels from agricultural crops. Production estimates, cost of raw products and value of by-products, 12:36638 (R;SE;In Swedish)
**Johnston, J.W.,** *See* Cushman, J.H., 12:36632
**Jokela, T.A.,** *See* Noshkin, V.E., 12:37852
**Jones, C.G.,** *See* Mitchell, M.E., 12:36960
**Jones, G.F.,** Consideration of the heat-removal factor for liquid-cooled flat-plate solar collectors, 12:36709 (J;GB)
**Jones, G.J.,** Designing photovoltaic systems, 12:36653 (BA;US)
**Jones, J.W.,** Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)
*See* Ellison, W., 12:36332
**Jones, K.W.,** *See* Gordon, B.M., 12:37873
**Jones, R.K.,** *See* Hahn, F.F., 12:37908
*See* Mauderly, J.L., 12:36476
**Jones, S.E.,** Enhancing the muon-catalyzed fusion yield, 12:38324 (R;US)
**Jones, T.A.,** *See* Rehbein, D.K., 12:37271
**Jones, T.D.,** *See* Morris, M.D., 12:37901
**Jones, W.R. Jr.,** *See* Lauer, J.L., 12:37344
**Jong, R.A.,** A high gain free electron laser amplifier design for the Alcator-C tokamak, 12:37518 (R;US)
**Jonsson, E.,** *See* Sauli, J., 12:36344
**Joos, K.,** Urban dendrochronology, 12:37755 (RA;US)
**Jordan, D.M.,** Physiological pH fiber-optic chemical sensor based on energy transfer, 12:37414 (J;US)
**Joselyn, J.,** Forecasts of solar and geomagnetic activity, 12:38059 (RA;US)
**Joseph, S.,** *See* Shah, Y., 12:36261, 12:36262, 12:36263, 12:36264
**Joshi, C.,** *See* Umstadter, D., 12:38365
**Joss, W.,** *See* Crabtree, G.W., 12:37205
**Jouet, J.,** Localized inductive heating of steel products, 12:37123 (RA;SE)
**Jouse, W.C.,** *See* Dallman, R.J., 12:36919
**Jozewicz, W.,** Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Jozsa, L.A.,** Direct reading x-ray densitometer, 12:38031 (RA;US)
**Juang, J.Y.,** *See* Rudman, D.A., 12:37283
**Julien, H.L.,** *See* Summers, M.A., 12:37487
**Jung, C.K.,** *See* Bowden, G., 12:37552
**Jung, Hong,** The EMC effect and related issues, 12:38269 (R;US)
**Juras, R.C.,** *See* Ziegler, N.F., 12:37547

## K

**Kadambi, J.R.,** Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period March 1, 1987 to May 31, 1987, 12:37493 (R;US)
**Kadro, A.,** Results of computerized multispectral scanning of forest damage, 12:37780 (RA;DE;In German)
**Kahana, S.,** Supernovae and high density nuclear matter, 12:38285 (BA;DE)
**Kahl, W.K.,** *See* Graves, R.L., 12:37160
**Kahler, M.,** *See* Kumar, S., 12:36762
**Kahn, E.,** Effect of conservation programmes on electric utility earnings: results of two case studies, 12:37001 (J;GB)
**Kahn, S.A.,** *See* Baker, N.J., 12:38243
**Kaiser, K.F.,** Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)
**Kalb, P.D.,** *See* Moskowitz, P.C., 12:36958
**Kalia, H.N.,** *See* Coyle, A.J., 12:36496
*See* Eckert, J.L., 12:36497
**Kalinovskij, Yu.L.,** Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
**Kalliokoski, P.,** *See* Pellikka, M., 12:37085, 12:37090
**Kallir, A.J.,** *See* Suter, G.W., 12:37382
**Kalus, W.,** *See* Diehl, J.F., 12:37817
**Kam, F.B.K.,** *See* Williams, M.L., 12:36777
**Kamat, P.V.,** Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene, 12:37433 (J;US)
**Kaminsky, J.,** *See* Karvelas, D., 12:37159
**Kammash, T.,** *See* Smithe, D.N., 12:38345
**Kammerud, R.,** *See* Bernard, M.J. III, 12:37016
**Kandpal, R.P.,** Characteristics of the formation of enzyme-bound ATP from medium inorganic phosphate by mitochondrial $F_1$ adenosinetriphosphatase in the presence of dimethyl sulfoxide, 12:37866 (J;US)
**Kang, Kyungsik,** *See* Feldman, D., 12:38158
**Kannberg, L.D.,** Ice condenser testing facility and plans, 12:36904 (RA;US)

**Kanosky, J.P.,** *See* Casleton, K.H., 12:36358
**Kanzleiter, T.,** Results from DEMONA aerosol experiments, 12:36902 (RA;US)
**Kapka, L.A.,** Single zone control systems, 12:37074 (R;US)
**Kaplan, N.,** *See* Kirchgessner, D.A., 12:37670
**Kappel, M.R.,** *See* Linn, C.J., 12:37186
**Karger, F.,** *See* Evans, T.E., 12:38380
**Karliner, M.,** *See* Banks, T., 12:38181
**Karner, F.R.,** *See* Schobert, H.H., 12:36323
**Karo, A.M.,** Molecular dynamics studies of energy transfer processes in crystal systems: Annual summary report, 12:38302 (R;US)
**Karvelas, D.,** Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)
*See* Teotia, A.P.S., 12:37018, 12:37024
**Karvonen, M.-L.,** *See* Korkala, T., 12:37093
**Kaser, M.,** Energy trade within Comecon, 12:36989 (RA;SE)
**Kashuba, R.J.,** *See* Smithe, D.N., 12:38345
**Katsuka, I.,** *See* Ishii, M., 12:36855
**Katrakis, J.,** Reducing temperature imbalance in single-pipe steam buildings, 12:37044 (RA;US)
*See* Evens, A., 12:37037
**Katsaounis, A.,** Agreement of model investigations of the critical heat flux in fuel element clusters, 12:36809 (R;DE;In German)
**Kaufherr, N.,** AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process, 12:37286 (R;US)
**Kaufman, A.N.,** *See* Friedland, L., 12:38342
**Kaufman, L.,** Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Annual report, 1 March 1986-27 February 1987, 12:37279 (R;US)
**Kaun, T.D.,** Molten salt battery advances, 12:36941 (R;US)
**Kautz, K.,** Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
**Kawabata, A.,** New heating technique for improving product quality and an example of its application, 12:37117 (RA;SE)
**Kawanishi, K.,** *See* Tsuge, A., 12:36917
**Kay, B.D.,** High field /sup 1/H NMR studies of sol-gel kinetics, 12:37313 (BA;US)
Quantum-resolved gas-surface scattering: NH/sub 3/ from Au (111), 12:38305 (BA;US)
**Kay, Bruce D.,** Silicate precursors: chemical kinetics, 12:37407 (R;US)
**Kenton, P.W.,** Low-thrust rocket trajectories, 12:36821 (R;US)
**Keddy, E.S.,** *See* Merrigan, M.A., 12:36803
**Keech, T.W. Jr.,** *See* Fasching, G.R., 12:36356
**Keefer, K.D.,** Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
*See* Brinker, C.J., 12:37316
*See* Schaefer, D.W., 12:37321
**Keegan, P.,** *See* Watson, R.H., 12:37059
**Kehrl, H.,** *See* Horstman, D., 12:37994
**Keller, H.,** *See* Klems, J.H., 12:37096
**Keller, J.O.,** Response of a pulse combustor to changes in total ignition delay time, 12:37523 (R;US)
**Keller, P.,** *See* Lehn, J.M., 12:36576
**Kelley, P.E.,** *See* McLuckey, S.A., 12:37383
**Kelley, W.H.,** Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
**Kelly, J.E.,** *See* Henninger, R.J., 12:36907
**Kelly, J.G.,** Neutron spectrum adjustment with SANDII using arbitrary trial functions, 12:36800 (R;US)
**Kelson, B.,** *See* Mc Fall, K.S., 12:36447
**Keltner, N.R.,** *See* Bainbridge, B.L., 12:37464
*See* Gregory, J.J., 12:37462
**Kemeny, J.M.,** *See* Ewy, R.T., 12:38044
**Kemper, K.W.,** *See* Van Verst, S.P., 12:38276
**Kempf, C.R.,** *See* Sullivan, T., 12:36521
**Kempton, J.P.,** Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: results of the Fall 1984 test-drilling program. Environmental geology notes, 12:37562 (R;US)
**Kennedy, B.M.,** *See* Hudson, G.B., 12:38070
**Kennedy, D.C. II,** Renormalization of electroweak interactions and the BREMMUS Monte Carlo simulator, 12:38167 (RA;US)
**Kennedy, J.M.,** *See* Pfeiffer, P.A., 12:36503
**Kennedy, R.,** *See* Hahn, F.F., 12:37929
**Kenoyer, J.L.,** Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring, 12:36555 (R;US)
**Kent, H.C.,** Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Kentula, M.E.,** EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)
**Kephart, J.O.,** *See* Moran, M.J., 12:37509
**Kerby, R.,** Anaerobic catabolism of formate to acetate and $CO_2$ by Butyribacterium methylotrophicum, 12:38008 (J;US)
**Kerfoot, H.B.,** Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
**Kerlin, T.W.,** Signal validation in nuclear power plants: Progress report No. 2, 12:36813 (R;US)
*See* Hashemian, H.M., 12:36774
**Kerr, R.M.,** *See* Ashurst, W.T., 12:38106
**Kerrisk, J.F.,** Groundwater chemistry at Yucca Mountain, Nevada, and vicinity, 12:36519 (R;US)
**Kerstein, A.R.,** *See* Ashurst, W.T., 12:38106
**Keskinen, J.,** Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
**Kessler, R.C.,** *See* Morris, R.E., 12:37659
**Ketchledge, E.H.,** *See* LeBlanc, D.C., 12:37805
**Kettler, C.N.,** Pulsed-laser photothermal refraction detection in capillary liquid chromatography, 12:37385 (J;US)
**Keville, B.J.,** Short-rotation harvester/chipper, 12:36633 (R;XE)
**Keyworth, G.A.,** Case for strategic defense: an option for a world disarmed, 12:37595 (R;US)
**Khatib-Rahbar, M.,** QUASAR uncertainty study, 12:36905 (RA;US)
**Khattak, C.P.,** Growth of garnet crystals for laser applications. Final report, 1 February-31 July 1984, 12:37485 (R;US)
**Khoo, T.L.,** Evolution of nuclear structure with spin and temperature, 12:38281 (BA;DE)
**Kicinska-Habior, M.,** Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}Cu$, 12:38244 (R;US)
**Kiefner, J.,** *See* Wilkowski, G.M., 12:36804
**Kiel, J.L.,** Metabolic effects of microwave radiation and convection heating on human mononuclear leukocytes. Final report, January 1985-May 1986, 12:38012 (R;US)
**Kienast, F.,** Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
**Kienle, P.,** *See* Tsertos, H., 12:38095
**Kier, P.H.,** *See* Bernard, M.J. III, 12:37016
*See* Collins, N.E., 12:37017
**Kierstead, H.A.,** *See* Dunlap, B.D., 12:37206
**Kilaas, R.,** Interactive software for simulation of high resolution TEM images, 12:38411 (R;US)
**Killian, T.H.,** *See* Corbo, P., 12:37826
**Killion, M.E.,** *See* Muscatello, A.C., 12:36490
**Killmeyer, R.P.,** FY 86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center, 12:36231 (R;US)
*See* Maronde, C.P., 12:36233
**Kim, C.M.,** *See* Acharya, A., 12:36449
**Kim, E.,** Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)
*See* Twery, M.J., 12:37454
**Kim, K.J.,** *See* Attwood, D., 12:37559
**Kim, Y.C.,** *See* Thompson, J.R., 12:37294
**Kimmel, J.,** *See* Keskinen, J., 12:37089
**Kincaid, W.B.,** Dendroecological analysis of ambient sulfur dioxide effects in western larch, 12:37947 (RA;US)
**King, C.M.,** Risk assessment of soil contamination criteria, 12:37821 (R;US)
**King, H.L.,** Subsurface-controlled geological maps for the Y-12 plant and adjacent areas of Bear Creek Valley, 12:38039 (R;US)
**King, S.,** *See* Watson, R.H., 12:37059
**King, W.E.,** The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
**King, Y.T.,** *See* Holten, M.L., 12:37447

**Kini, A.M.,** 4,5-methylenedithio-4',5'-propylenedithiotetrathiafulvalene (MPT) and 4,5-ethylenedithio-4',5'-propylenedithiotetrathiafulvalene (EPT), 12:37389 (R;US)
**Kipp, M.E.,** *See* Horie, Y., 12:38300
**Kirby, R.,** Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK , 12:36733 (R;GB)
**Kirchgessner, D.A.,** Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
**Kirchgessner, J.,** *See* Biallas, G., 12:37548
**Kirchoff, T.A.,** *See* Shinn, M.D., 12:37474
**Kirkpatrick, A.T.,** Interzonal mixed convection heat transfer in a passive solar building, 12:36695 (BA;US)
**Kirkpatrick, D.T.,** Effect of exogenous sources of cysteine on lung glutathione levels, 12:37982 (RA;US)
Effect of time of glutathione depletion on ozone-induced pulmonary fibrosis, 12:37975 (RA;US)
**Kispert, L.D.,** Catalyst accessibility in high volatile bituminous coal: Quarterly report, 12:36316 (R;US)
Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987, 12:37435 (R;US)
**Kissell, F.N.,** *See* Timko, R.J., 12:36342
**Kivistoe, A.,** *See* Jaemsae, S., 12:37091
**Klammer, H.,** *See* Schupe, W., 12:37113
**Klarer, P.R.,** *See* Harrington, J.J., 12:36570
**Kleesattel, D.R.,** *See* Schobert, H.H., 12:36323
**Klein, S.A.,** *See* Malkin, M.P., 12:36688
**Kleman, J.,** Spectral signatures of damaged spruce stands measured from a helicopter, 12:37772 (RA;DE)
**Klemm, J.,** *See* Weitz, R., 12:37591, 12:37592
**Klemperer, W.G.,** A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
**Klems, J.H.,** Measurement of single and double glazing thermal performance under realistic conditions using the mobile window thermal test (MoWiTT) facility, 12:37096 (BA;US)
**Klesch, D.R.,** *See* Bougault, R., 12:38254
**Klett, R.D.,** Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
**Klimas, P.C.,** Sandia National Laboratories 34-meter diameter vertical axis wind turbine test bed, 12:36747 (BA;US)
**Kline, W.H.,** Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)
**Klinken, J. van,** *See* Voigt, M.J.A. de, 12:38258
**Klinzing, G.E.,** *See* Ekmann, J.M., 12:36350
**Klokk, T.,** *See* Denstad, J.P., 12:36423
**Klopfer, P.,** *See* Winkelmann, I., 12:37710
**Klots, C.E.,** The evaporative vector: Homogeneous systems, 12:38094 (R;US)
**Klug, W.,** Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)
**Kmetyk, L.N.,** Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
**Knapp, C.E.,** Optical analysis of high power free electron laser resonators, 12:37484 (R;US)
**Knapp, D.A.,** The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
*See* Bowles, T.J., 12:38152
**Knapp, F.F. Jr.,** Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)
**Knapp, J.A.,** *See* Follstaedt, D.M., 12:37240
**Knapp, K.T.,** *See* Durham, J.L., 12:37646
**Knepton, J.,** Evaluation of drugs for prevention of hyperthermia in rats exposed to microwave irradiation. Final report, 1983-1985, 12:38013 (R;US)
**Knies, G.,** *See* Bartel, W., 12:38117
**Knight, T.D.,** *See* Spore, J.W., 12:36867
**Knight, T.F.,** *See* Penfield, P., 12:38402
**Knight, T.J.,** Self-protection of Pseudomonas syringae pv. tabaci from its toxin, tabtoxinine-$\beta$-lactam, 12:37881 (J;US)
**Knoess, C.,** *See* Paik, C.Y., 12:36853
**Knowles, M.,** *See* Weitz, R., 12:37591, 12:37592
**Knowlton, S.,** *See* Greenwald, M., 12:38326
**Kobos, A.M.,** An optical model analysis of $^{16}O + {}^{12}C$ elastic scattering at E/A = 94 MeV, 12:38266 (R;US)
**Koch, G.H.,** *See* Thompson, N.G., 12:36458
**Kocher, D.C.,** A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
Considerations on a de minimis dose and disposal of exempt concentrations of radioactive wastes, 12:36525 (R;US)
**Kocher, L.F.,** *See* Smith, D.E., 12:36815
**Koehler, H.,** *See* Winkelmann, I., 12:37710
**Koehler, M.J.,** *See* Hewett, M.J., 12:37041, 12:37042
**Koelling, D.D.,** *See* Arko, A.J., 12:37204
**Koenig, W.,** *See* Tsertos, H., 12:38095
**Koepke, J.,** *See* Voet, D., 12:37861
**Koepke, M.E.,** *See* Ribe, F.L., 12:38336
**Kofod, P.,** Development of an efficient and inexpensive concentrating solar collector, 12:36702 (R;DK;In Danish)
**Kogan, V.,** *See* Gieseke, J.A., 12:36909
**Kohama, S.,** *See* Nakatsuka, M., 12:37126
**Kohl, R.,** *See* Winkelmann, I., 12:37710
**Kohlmeyer, B.,** *See* Sohlbach, H., 12:38260
**Koizumi, Y.,** *See* Tasaka, K., 12:36848
**Kolar, W.,** JRC ISPRA experience with the IBM version of RELAP5/MOD2, 12:36884 (RA;US)
**Kolb, E.W.,** Baryon and lepton number violation in astrophysics, 12:38078 (BA;DE)
**Kolb, N.L.,** *See* Corbo, P., 12:37826
**Kolos, W.,** *See* Fackler, O., 12:38198
**Kominsky, J.R.,** Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma, 12:37675 (R;US)
*See* McManus, K.P., 12:37680
*See* Seiler, F.A., 12:37620
**Konisky, J.,** *See* Santoro, N., 12:37872
**Konnan, J.I.,** *See* Conway, T., 12:37867
**Kono, Hisashi O.,** Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986, 12:36354 (R;US)
**Kontic, R.,** Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Comparative studies on the annual ring pattern and crown condition of conifers (the Valais, Switzerland), 12:37754 (RA;US)
**Koo, R.,** Effects of message loss on distributed termination. Technical report, 12:38417 (R;US)
**Koo, Y.J.,** *See* Cocco, R.A., 12:37425
**Kooriyama, T.,** *See* Tsuge, A., 12:36917
**Korkala, T.,** Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Korpics, J.J.,** *See* Bullin, J.A., 12:37184
**Kosik, D.W.,** *See* Wright, L.E., 12:38275
**Kosky, P.G.,** *See* Maylotte, D.H., 12:36299
**Kotchick, D.,** *See* Stillwagon, T., 12:37500
**Kotchick, D.M.,** *See* Stillwagon, T.L., 12:37138
**Kothari, B.,** *See* D'Ottavio, T.W., 12:37709
**Kotowski, M.J.,** Pressure safety training for a large research and development facility, 12:38017 (R;US)
**Kovacs, E.V.,** *See* Bodwin, G.T., 12:38214
**Kozhuharov, C.,** *See* Tsertos, H., 12:38095
**Krafft, G.A.,** *See* Bisognano, J.J., 12:37541
**Kraft, G.,** Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)
**Kraft-Weyrather, W.,** *See* Kraft, G., 12:37904
**Kraichnan, R.H.,** Interpretation of the Yakhot—Orszag turbulence theory, 12:38108 (J;US)
**Kramer, G.,** *See* Wilkowski, G.M., 12:36804
**Krehbiel, H.,** *See* Bartel, W., 12:38117
**Kreilick, T.S.,** *See* Gregory, E., 12:37255
**Kreisler, M.N.,** *See* Sullivan, M.W., 12:38151
**Kreuter, P.,** Studies on engine output control for internal combustion engines, 12:37165 (R;DE;In German)
**Krist, S.E.,** Algorithm implementation on the Navier-Stokes computer, 12:37495 (R;US)
**Kristensen, J.W.,** *See* Jensen, S.A., 12:36743
**Kristiansen, P.S.,** Energy saving by means of mutual adjustment of tractor and tools size, 12:37149 (R;DK;In Danish)
**Kristoff, F.T.,** Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)
**Kritikos, G.,** Comparative damage classifications using scanner data from from different flight altitudes, 12:37781 (RA;DE;In German)

**Kroeger, D.M.,** *See* Bentley, J., 12:37290
**Kroemer, H.,** *See* Liliental-Weber, Z., 12:37340
**Krommes, J.A.,** Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence, 12:38349 (R;US)
**Krumholz, L.R.,** Metabolism of gallate and phloroglucinol in Eubacterium oxidoreducens via 3-hydroxyl-5-oxohexanoate, 12:38009 (J;US)
**Krupke, W.F.,** *See* Shinn, M.D., 12:37474
**Kuan, P.,** *See* Tolman, E.L., 12:36896
**Kucheida, D.,** *See* Winkelmann, I., 12:37710
**Kuchuk, F.J.,** New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)
**Kuebler, D.,** *See* Kritikos, G., 12:37781
**Kuhl, W.-E.,** Colour infrared air-photointerpretation by hexagon-methods to detect forest decline in Northrhine-Westphalia, 12:37777 (RA;DE)
**Kuhlman, M.R.,** *See* Gieseke, J.A., 12:36909
**Kuhlmeier, P.D.,** Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)
**Kuhn, W.L.,** *See* Pulsipher, B.A., 12:36528
**Kukita, Y.,** *See* Tasaka, K., 12:36848
**Kulhowvick, G.,** *See* Wilkowski, G.M., 12:36804
**Kulmala, M.,** Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
*See* Kulmala, M., 12:37092
*See* Raunemaa, T., 12:37094
*See* Saari, H., 12:37088
**Kulmala, V.,** *See* Keskinen, J., 12:37089
**Kumar, S.,** Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report, 12:36762 (R;US)
*See* Ramachandran, N., 12:37108
**Kummer, J.P.,** Three freeze protection methods applied to a large solar energy system, 12:36671 (BA;US)
**Kung, H.H.,** Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Kuntamukkula, M.S.,** *See* Heller, J.P., 12:37415
**Kuntz, S.,** *See* Kadro, A., 12:37780
**Kunz, C.,** *See* D'Ottavio, T.W., 12:37709
**Kunz, P.F.,** Aspects of computing in high energy physics, 12:38109 (RA;US)
**Kupfer, D.M.,** *See* McCarthy, D., 12:37871
**Kupper, W.,** *See* Dix, W.R., 12:37875
**Kupperman, D.S.,** Acoustic leak detection for district heating systems: Results of Phase 1: Laboratory assessment, 12:37153 (R;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
**Kuppler, D.,** *See* Schroeder-Obst, D., 12:37202
**Kuszmaul, J.S.,** A new constitutive model for fragmentation of rock under dynamic loading, 12:36467 (R;US)
*See* Gorham-Bergeron, E., 12:36466
**Kutschera, W.,** Present and future prospects of accelerator mass spectrometry, 12:37370 (R;US)
**Kuusela, K.,** Observed tree diseases and forest damages in the Finnish National Forest Inventory, 12:37787 (RA;DE)
**Kuuskraa, V.A.,** *See* Zuber, M.D., 12:36445
**Kuwabara, K.,** *See* Tsuge, A., 12:36917
**Kwak, J.F.,** *See* Nigrey, P.J., 12:37408
*See* Schirber, J.E., 12:37305
**Kwiatek, W.M.,** *See* Gordon, B.M., 12:37873
**Kwiatkowski, K.,** *See* Bougault, R., 12:38254
**Kwo, J.,** *See* Ekin, J.W., 12:37288
**Kwok, W.,** *See* Dunlap, B.D., 12:37206
**Kwoka, C.D.,** *See* Seiler, F.A., 12:37620
**Kydes, A.S.,** An assessment of the graphics upgrade needs of technology policy: Office of Policy, Planning and Analysis, 12:38407 (R;US)
**Kylloenen, H.,** *See* Arpiainen, V., 12:36278

## L

**Laaksonen, J.,** *See* Keskinen, J., 12:37089
**Laats, E.T.,** Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
**Labreche, D.A.,** The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project, 12:38046 (R;US)
**Lachai, B.,** *See* Guisan, O., 12:36703
**Lacy, S.E.,** *See* Fisher, R.A., 12:37227, 12:37228
**LaFlesh, R.C.,** *See* Rini, M.J., 12:36361
**LaForte, J.T.,** *See* Anderson, J.M., 12:36754
**Laget, R.,** Concentration principle applied to spaceborne solar arrays. AGORA mission: studies synthesis, 12:36637 (R;FR)
**Lagus, P.L.,** *See* Stormont, J.C., 12:36540
**Lai, K.F.,** *See* Mau, T.K., 12:38355
**Lake, L.W.,** *See* Pope, G.A., 12:36379
**Lakenberg, E.,** Combination of different methods of surveying and analysing forest decline to create a basis to investigate the causes, as practised in West-Berlin, 12:37601 (RA;DE;In German)
**Lam, D.J.,** *See* Arko, A.J., 12:37204
*See* Dunlap, B.D., 12:37206
**Lam, J.F.,** Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987, 12:38091 (R;US)
**Lamb, D.Q.,** *See* Imamura, J.N., 12:38074
**Lamb, J.A.,** *See* Thornton, J.A., 12:36706
**Lamb, R.G.,** Air-pollution models as descriptors of cause-effect relationships, 12:37638 (R;US)
**Lambert, G.,** *See* Ishii, M., 12:36855
**Lambert, J.,** *See* Grisham, D.L., 12:38415
**Lambertson, G.,** *See* Diebold, R., 12:37536
**Lamby, E.J.,** *See* Maylotte, D.H., 12:36299
**Lampe, F.W.,** The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Landow, M.,** *See* Wilkowski, G.M., 12:36804
**Lang, K.R.,** Simultaneous SMM flat-crystal spectrometer and Very Large Array observations of solar-active regions, 12:38056 (R;US)
Solar-active region physical parameters inferred from a thermal cyclotron line and soft-x-ray spectral lines, 12:38054 (R;US)
Very Large Array observations of the sun with related observations using the SMM (Solar Maximum Mission) satellite. Interim report, 1 January-31 December 1986, 12:38053 (R;US)
VLA (Very Large Array) observations of a solar-noise storm, 12:38055 (R;US)
**Langdon, A.B.,** *See* Hewett, D.W., 12:38356
**Lange, F.F.,** *See* Marshall, D.B., 12:37278
**Langer, G.,** Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor, 12:36822 (R;DE;In German)
**Langley, K.F.,** *See* Buckley-Golder, D.H., 12:37004
**Langner, G.H. Jr.,** Validation of the abbreviated Radon Progeny Integrating Sampling Unit (RPISU) method for Mesa County, Colorado, 12:37820 (R;US)
**Langston-Unkefer, P.J.,** *See* Knight, T.J., 12:37881
**Lanou, R.E.,** *See* Ahrens, L.A., 12:38150
**Lanou, R.E. Jr.,** A research program in experimental high energy physics: Task C, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38118 (R;US)
**Larsen, J.,** *See* Rapaport, J., 12:38241
**Larsen, J.W.,** *See* Cheng, J.C., 12:36270
**Larson, D.C.,** *See* Hetrick, D.M., 12:38274
**Larson, T.K.,** *See* Condie, K.G., 12:36841
**Laseke, B.A.,** *See* Jones, J.W., 12:36761
**Laseter, W.A.,** Environmental monitoring report for Pantex Plant covering 1986, 12:36550 (R;US)
**Lashmore-Davies, C.N.,** *See* Fuchs, V., 12:38328
**Lassoie, J.P.,** *See* Sheppard, P.R., 12:37746
**Last, J.,** *See* Freedman, S.J., 12:38153
**Lathrop, R.C.,** *See* McClenahen, J.R., 12:37956
**Latorre, V.R.,** Numerical assessment of high frequency (HF) antennas for shipboard use, 12:37466 (R;US)
**Latzko, E.,** *See* Holtum, J.A.M., 12:37905
**Lauer, J.L.,** Investigation of PTFE transfer films by infrared emission spectroscopy and phase-locked ellipsometry, 12:37344 (R;US)
**Lauf, R.J.,** An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
*See* Bentley, J., 12:37290
**Laughlin, J.K.,** Study of saline water use at the Harry Allen Generating Station. Final report, 12:36756 (R;US)

**Laul, J.C.,** Trace rare earth element analysis in briny groundwaters, 12:38045 (R;US)
**Laurens, R.M.,** *See* Anderson, G.L., 12:37011
**Laurikainen, P.,** *See* Bartel, W., 12:38117
**Lavelle, J.W.,** *See* Tennant, D.A., 12:37842
**Lavine, T.L.,** Bound on the number of neutrinos from $e^+e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA, 12:38128 (RA;US)
**Law, B.E.,** *See* Charpentier, R.R., 12:36431
**Lawless, P.A.,** Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985, 12:37652 (R;US)
**Lawson, L.O.,** Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)
*See* Maloney, D.J., 12:36359
**Lay, R.,** Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**Layton, D.W.,** Demilitarization of conventional ordnance: Priorities for data-base assessments of environmental contaminants, 12:37584 (R;US)
**Lazareth, O.W.,** Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
**Le Mentec, O.,** Numerical simulation of marine seismic source signature and of their interaction. Application to the watergun, 12:38042 (R;FR;In French)
**Le Neindre, B.,** *See* Nieuwoudt, J.C., 12:37416
**Leander, G.A.,** Electromagnetic properties of nuclei at high spins, 12:38280 (BA;DE)
**Leavitt, S.W.,** Influence of site disturbance on $\delta^{13}C$ isotopic time series from tree rings, 12:38019 (RA;US)
*See* Long, A., 12:37604
**LeBlanc, D.C.,** Characterization of historical growth patterns in declining red spruce trees, 12:37805 (RA;US)
**Leden, B.,** Mathematical reheating furnace models in STEELTEMP, 12:37106 (RA;SE)
*See* Jarl, M., 12:37214
**Lederman, L.M.,** *See* Huson, R., 12:37574
**Lee, C.K.,** *See* Savastano, C.A., 12:37424
**Lee, D.D.,** *See* Bienkowski, P.R., 12:37860
**Lee, J.,** *See* Miller, J.F., 12:36947
**Lee, J.C.,** *See* Moskowitz, P.C., 12:36958
**Lee, K.,** *See* Mihaly, L., 12:37355
**Lee, K.W.,** *See* Gieseke, J.A., 12:36909
**Lee, M.,** *See* Khatib-Rahbar, M., 12:36905
**Lee, M.C.,** *See* Schilling, C.H., 12:37302
**Lee, P.H.Y.,** On relativistic self focusing, 12:38387 (J;GB)
**Lee, R.L.,** *See* Leone, J.M. Jr., 12:37728
**Lee, R.W.,** Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)
**Lee, S.A.,** Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
**Lee, S.C.,** Polarization density matrix for heavy Qanti Q production in hadron colliders, 12:38203 (J;NL)
**Lee, S.J.,** *See* Branagan, P.T., 12:36457
**Lee, S.K.,** Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)
**Lee, S.S.,** *See* Thompson, R.B., 12:37265
**Lee, T.D.,** Theoretical high energy physics: Progress report for the period May 1, 1986-April 30, 1987, 12:38157 (R;US)
**Lee, T.J.,** The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory, 12:37402 (R;US)
**Lee, W.H.,** Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
**Lee, W.J.,** *See* Sullivan, R.B., 12:36455
**Lee, W.W.,** Gyrokinetic particle simulation of ion temperature gradient drift instabilities, 12:38353 (R;US)
**Lee-Tuffnell, C.D.,** Model surfactant studies 1: preliminary investigations of phase behaviour, 12:36368 (R;GB)
**Leemann, C.W.,** The CEBAF [Continuous Electron Beam Accelerator Facility] superconducting accelerator: An overview, 12:37530 (R;US)
*See* Grunder, H.A., 12:37532
**Lees, D.E.B.,** Computer-aided radiograph analysis, 12:37507 (R;US)
**Leet, W.A.,** Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)
**Lehn, J.M.,** Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)
**Lehnert, B.E.,** *See* Stavert, D.M., 12:37959
**Leich, D.A.,** *See* Lindner, M., 12:38257
**Leider, H.R.,** An attempt to use high resolution FTIR spectra to determine the population of the various nitrate esters in cellulose nitrate, 12:37381 (R;US)
Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring, 12:37585 (R;US)
**Leigh, C.D.,** MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
**Leigh, J.A.,** Genetics and biochemistry of the Rhizobium meliloti acidic extracellular heteropolysaccharide and its role in nodulation: Annual report for the period 1 June 1986-31 May 1987, 12:36626 (R;US)
*See* Cangelosi, G.A., 12:37865
**Leighton, F.T.,** *See* Penfield, P., 12:38402
**Leistritz, F.L.,** *See* Murdock, S.H., 12:36544
**Lenihan, K.L.,** Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
*See* Sheehy, J.W., 12:37685
**Leonard, R.A.,** Modeling americium separations in stagewise solvent extraction, 12:37437 (R;US)
**Leone, J.M. Jr.,** Numerical simulation of flow in Brush Creek Valley, Colorado, 12:37728 (R;US)
**Lepel, E.A.,** *See* Laul, J.C., 12:38045
**Lesinski, J.,** *See* Westman, L., 12:37939
**Leslie, D.C.,** *See* Black, P.S., 12:36881
**Lestz, S.S.,** *See* Hoffman, J.S., 12:37635
**Lettenmaier, D.P.,** Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report, 12:36610 (R;US)
**Leuschner, H.,** *See* Worbes, M., 12:38022
**Leuschner, H.H.,** Dendrochronological study of oak trunks found in bogs in northwest Germany, 12:38025 (RA;US)
**Lev, D.J.,** Biological inference from growth-climate correlations in balsam poplar in Alaska, 12:37742 (RA;US)
**Levelt Sengers, J.M.H.,** *See* Gallagher, J.S., 12:36725
**Levi, M.,** Status report on the Mark II Energy Measurement System, 12:37551 (RA;US)
**Levine, M.,** *See* Kahn, E., 12:37001
**Levine, M.D.,** *See* Ruderman, H., 12:37097
**Levinton, F.M.,** Measurement of the local particle diffusion coefficient in a magnetized plasma, 12:38357 (J;US)
**Levitz, N.M.,** *See* Graczyk, D.G., 12:36782
**Levy, I.S.,** Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas, 12:36494 (R;US)
**Lewandowski, A.,** An assessment of the potential benefits of secondaries in point-focus concentrators, 12:36711 (BA;US)
**Lewis, A.E.,** Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)
**Lewis, E.A.,** *See* Eatough, D.J., 12:36260
**Lewis, E.P.,** *See* Hardman-Rhyne, K.A., 12:37312
**Lewis, H.R.,** *See* Schwarzmeier, J.L., 12:38363
**Lewis, J.B.,** *See* Reisman, D.J., 12:37990
**Lewis, J.D.,** *See* Thompson, J.R., 12:37212
**Lewis, T.A.,** *See* Alsmiller, R.G. Jr., 12:37544
**Lewtas, J.,** Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Leytham, K.M.,** *See* Lettenmaier, D.P., 12:36610
**Lhersonneau, G.,** *See* Meyer, R.A., 12:38256
**Li, Che-Yu,** *See* Carolan, R.A., 12:37231
**Li, J.C.M.,** *See* Vianco, P.T., 12:37253
**Li, X.L.,** *See* Deniz, A.V., 12:38361
**Li, Z.,** *See* Halbert, M.L., 12:38251
**Lidl, J.,** *See* Neureither, B., 12:37525
**Lieber, J.G.,** *See* Tewari, P.H., 12:37322
**Liesch, K.,** *See* Riegel, B., 12:36864
**Lighthart, M.,** *See* Bown, J.R., 12:36425
**Ligotke, M.W.,** *See* Kannberg, L.D., 12:36904
**Liles, D.R.,** *See* Spore, J.W., 12:36867
**Liliental-Weber, Z.,** Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)

The structure of GaAs/Si(211) heteroepitaxial layers, 12:37340 (R;US)
**Lilly, W.D.,** *See* Calo, J.M., 12:36271
**Lim, K.,** Stress analysis of spherically curved triangular solar panels, 12:36719 (BA;US)
*See* Vallabhan, C.V.G., 12:36720
**Lim, R.W.,** *See* Schneider, C.A., 12:37880
**Limaye, S.,** Proceedings: 1986 Electric Utility Market Research symposium, 12:36995 (R;US)
**Lin, C.S.,** *See* Cheng, C.Z., 12:38350
**Lin, H.M.,** *See* Leet, W.A., 12:37418
**Lin, P.,** *See* Kaufherr, N., 12:37286
**Lin, W.K.,** Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend, 12:36854 (RA;US)
**Lindberg, S.E.,** *See* Coe, J.M., 12:36321
**Lindemer, T.B.,** Molybdenum resistance heater, 12:37524 (J;US)
**Lindenbaum, S.J.,** Experimental investigations of production of glueballs and meson resonant states, 12:38123 (R;US)
**Linders, J.R.,** *See* Rockefeller, G.D., 12:36767
**Linderstad, H.,** Dense in a right way. Energy aspects on the expansion of Gothenburg, 12:37021 (R;SE;In Swedish)
**Lindgren, R.A.,** *See* Hicks, R.S., 12:38240
**Lindholm, M.,** Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Lindl, J.D.,** *See* Mark, J.W.K., 12:38385
**Lindner, J.S.,** *See* Wang, C.S., 12:37005
**Lindner, M.,** Laboratory determination of the half-life of $^{187}$Re, a nuclide of cosmological interest, 12:38257 (BA;DE)
**Lindner, R.,** Passenger-car emissions in the speed range 80-120 kmph. Traffic measurements on a fleet of cars in the Pfaender Road Tunnel, 12:37183 (R;XE;In German)
**Lindsay, C.N.,** A measurement control study for tritium gas, 12:36563 (R;US)
**Linn, C.J.,** Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report, 12:37186 (R;US)
**Linn, J.L.,** *See* Linn, C.J., 12:37186
**Linsky, D.,** *See* Gallagher, J.S., 12:36725
**Linstrom, P.J.,** *See* Carter, J.P., 12:37634
**Linteris, G.T.,** *See* Dutt, G.S., 12:37035
**Liou, S.H.,** *See* Ekin, J.W., 12:37288
**Lipfert, F.W.,** The role of dry deposition in acidification of waters, 12:37767 (R;US)
**Lipkin, H.J.,** Are the Dirac strings harmless?, 12:38317 (BA;US)
**Liske, K.,** *See* Brosch, G., 12:37099
**Lisa, S.A.,** Alaska geothermal bibliography, 12:36721 (R;US)
**Litterst, F.J.,** *See* Dunlap, B.D., 12:37206
**Littlejohn, D.,** NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
**Litton, C.D.,** *See* Egan, M.R., 12:36366
**Liu, C.T.,** *See* McKamey, C.G., 12:36240, 12:36251
**Liu, D.K.,** Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
**Liu, T.Y.,** *See* Liliental-Weber, Z., 12:37340
**Liveright, T.,** *See* Mehta, M., 12:37700
**Lloyd, J.N.,** Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
**Loeppke, G.E.,** *See* Ortega, A., 12:36726
**Loewenstein, W.B.,** Nuclear safety—forward on technology and backward on perception, 12:36889 (RA;US)
**Lof, G.O.G.,** Performance of a solar desiccant cooling system, 12:36697 (BA;US)
**Lofftus, K.D.,** *See* Tewari, P.H., 12:37322
**Logan, R.G.,** *See* Romanosky, R.R. Jr., 12:36309
**Logan, T.J.,** Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)
**Logan, T.L.,** Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)
**Lohmann, R.P.,** *See* Sattar, M.A., 12:37343
**Long, A.,** Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
*See* Leavitt, S.W., 12:38019
**Long, E.L. Jr.,** *See* Graves, R.L., 12:37160
**Long, G.J.,** *See* Gordon, B.M., 12:37873
**Long, L.W.,** *See* Mitchell, M.E., 12:36960
**Long, M.,** *See* de Meulemeester, A., 12:37647
**Longest, A.W.,** *See* Adams, R.E., 12:36898
**Longhurst, G.R.,** *See* Holland, D.F., 12:38378
**Looney, B.B.,** Transport of organic contaminants in coastal plain sediments, 12:37808 (R;US)
**Lovell, A.J.,** Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)
**Lowden, R.A.,** Effect of infiltration conditions on the properties of SiC/Nicalon composites, 12:37301 (R;US)
**Lowe, S.T.,** Recent results from the crystal ball experiment, 12:38138 (RA;US)
**Lucas, G.E.,** *See* Theofanous, T.G., 12:36914
**Lucas, H.F.,** An improved method for the simultaneous determination of $^{224}$Ra, $^{226}$Ra and $^{228}$Ra in water, soils and sediments, 12:37848 (R;US)
*See* Rowland, R.E., 12:37935
**Lucas, M.C.,** *See* Dowdy, E.J., 12:37572
**Lucas, P.,** Simulation of space charge effects and transition crossing in the Fermilab Booster, 12:37543 (R;US)
**Luco, J.E.,** Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**Ludewig, H.,** *See* Lazareth, O.W., 12:36779
*See* Slovik, G., 12:36784
**Ludwick, G.E.,** Super gripper variable vane arm, 12:37166 (P;US)
**Luffel, D.L.,** Reliability of laboratory measurement of porosity in tight gas sands, 12:36432 (BA;US)
**Luft, W.,** High-rate deposition of hydrogenated amorphous silicon films and devices, 12:36636 (R;US)
**Lukens, L.L.,** Liquid metal thermal electric converter, 12:36657 (R;US)
**Lumpkin, A.H.,** Cherenkov and transition radiation diagnostics for high energy free-electron lasers, 12:37483 (R;US)
**Luna, R.E.,** *See* Freedman, J.M., 12:37465
**Lund, H.G.,** International monitoring - an achievable goal, 12:37771 (RA;DE)
**Lund, J.R.,** *See* Lettenmaier, D.P., 12:36610
**Lundgren, D.L.,** Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. II, 12:37925 (RA;US)
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
*See* Hahn, F.F., 12:37908
*See* Muggenburg, B.A., 12:37917
**Lundstroem, E.,** Occupant influence on energy consumption in single-family dwellings, 12:37019 (R;SE)
**Lurmann, F.W.,** Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 1. Adaptation of the mechanism. Final report, March 1986-February 1987, 12:37660 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 2. Guidelines for using the mechanism. Final report, March 1986-February 1987, 12:37661 (R;US)
**Luthy, R.G.,** *See* Sczurko, J.J., 12:37396
**Lyczkowski, R.W.,** Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)
**Lynch, D.W.,** *See* Chen, L., 12:37251
**Lynch, V.E.,** *See* Holmes, J.A., 12:38332
**Lynch, W.G.,** *See* Bougault, R., 12:38254
**Lynn, A.L.,** *See* Anderson, J.M., 12:36754
**Lynn, B.W.,** *See* Kennedy, D.C. II, 12:38167
**Lynn, J.E.,** Coriolis interaction and variable reflection asymmetry in fission vibrational resonances, 12:38277 (J;US)
**Lynn, S.,** *See* Demyanovich, R.J., 12:37411
**Lyon, J.F.,** Review of the Advanced Toroidal Facility program, 12:38368 (R;US)
**Lyons, L.R.,** *See* Dusenbery, P.B., 12:38081

## M

**Ma, B.M.,** *See* Ramesh, R., 12:37225
**Macario, A.J.L.,** Antigenic mosaic of Methanogenium spp.: analysis with poly- and monoclonal antibody probes, 12:37882 (J;US)
**MacEwen, S.R.,** *See* Flower, E.C., 12:37244
**Macias, J.R.,** [Dimerization of o-quinodimethanes], 12:37399 (R;US)
**Maciel, G.E.,** *See* Ryan, M.A., 12:37356
**Mack, M.E.,** *See* Plourde, B.E., 12:37489

**Macklin, R.L.**, Neutron capture resonances of /sup 152/Gd and /sup 154/Gd, 12:38278 (J;US)
**MacLachlan, J.**, *See* Lucas, P., 12:37543
**Maddox, P.**, Alternative flow control nozzles: energy dissipation of highly erosive fluids, 12:36247 (RA;US)
**Magnani, N.J.**, Exploratory Battery Technology Development and Testing report for 1985, 12:36944 (R;US)
**Magnussen, N.**, *See* Bartel, W., 12:38117
**Mahajan, B.M.**, Flow coefficients for interzonal natural convection for various apertures, 12:36691 (BA;US)
**Mahmood, S.M.**, Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)
**Mahoney, J.A.**, *See* Pacheco, M.A., 12:36290
**Mahtout, T.**, Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
**Mainz, V.V.**, *See* Klemperer, W.G., 12:37318, 12:37319
**Maio, S.M.**, *See* Sun, J.D., 12:37968
**Majkrzak, C.F.**, Artificial magnetic superlattices, 12:38295 (R;US)
**Makdisi, Y.**, *See* Sullivan, M.W., 12:38151
**Malatini, S.**, Environmental indicators: a comparison of international trends, 12:37857 (R;IT;In Italian)
**Maley, M.P.**, *See* Bowles, T.J., 12:38152
*See* Knapp, D.A., 12:38236
**Malik, S.K.**, *See* Dunlap, B.D., 12:37206
**Malkin, M.P.**, A design method for thermosyphon solar domestic hot water systems, 12:36688 (J;US)
**Mall, G.H.**, *See* Singh, J.J., 12:36462
**Mallen, A.N.**, *See* Cheng, H.S., 12:36811
*See* Wulff, W., 12:36869
**Mallik, U.**, J/psi spectroscopy from MARK III, 12:38139 (RA;US)
**Mallya, N.**, *See* Helt, J.E., 12:37154
**Malone, G.**, *See* Lay, R., 12:36926
**Maloney, D.J.**, Imaging and control instrumentation for studying the combustion behavior of single fuel droplets, 12:36359 (RA;US)
**Maluf, J.W.**, Conformal invariance and torsion in general relativity, 12:38314 (J;GB)
**Manahan, S.E.**, Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
**Mancini, T.R.**, *See* Ratzel, A.C., 12:36712
**Mandallaz, D.**, Use of logistic regression model in the statistical analysis of forest damage, 12:37802 (RA;DE)
**Mandenius, C.F.**, Controlling of processes for producing energy carriers by means of biotechnique, 12:36602 (R;SE;In Swedish)
**Mandl, R.M.**, PKL III small breaks and transients experimental program, 12:36843 (RA;US)
**Manes, K.R.**, Multimegajoule laser design, 12:37486 (R;US)
**Mangan, D.L.**, Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
**Mangold, B.L.**, *See* Dalton, J.P., 12:37900
**Manickam, J.**, Ideal MHD stability properties of pressure-driven modes in low shear tokamaks, 12:38348 (R;US)
**Mann, F.M.**, 1986 evaluation of delayed-neutron emission probabilities, 12:38245 (R;US)
**Mann, L.G.**, *See* Meyer, R.A., 12:38256
**Manning, D.L.**, *See* Maskarinec, M.P., 12:37377
**Manogue, W.H.**, *See* Bischoff, K.B., 12:36597
**Mansur, L.K.**, Kinetic theory of radiation effects, 12:37207 (R;US)
**Mantsch, P.**, 1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components, 12:37538 (BA;US)
*See* Diebold, R., 12:37536
**Marcenat, C.**, *See* Fisher, R.A., 12:37227, 12:37228
**Marciano, W.J.**, Electroweak radiative corrections and neutral current phenomenology, 12:38112 (R;US)
**Marcin, M.**, *See* Sullivan, M.W., 12:38151
**Marcus, H.L.**, *See* Persad, C., 12:37200
**Marechal, P.**, Present and future applications of remote detection, 12:37774 (RA;DE;In French)
*See* Felten, V., 12:37773
**Margaris, N.S.**, Quality and quantity of latex which can be produced from natural vegetation in Greece, 12:36630 (R;FR)
**Margetan, F.J.**, *See* Gray, T.A., 12:37273
**Margolis, S.H.**, *See* Schinder, P.J., 12:38205
**Marietta, M.G.**, Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
**Marine, I.W.**, *See* Corbo, P., 12:37826
**Marinescu, M.**, *See* Sohlbach, H., 12:38260
**Marino, M.**, Research and development activities on the Free Electron Laser (FEL) at the ENEA Frascati Energy Researches Center, 12:37475 (R;IT;In Italian)
**Marion, J.E.**, *See* Summers, M.A., 12:37487
**Mark, J.W.K.**, Near spherical illumination of ion-beam and laser targets, 12:38384 (R;US)
Symmetry issues in a class of ion beam targets using sufficiently short direct drive pulses, 12:38385 (R;US)
**Marking, L.L.**, *See* Havlik, M.E., 12:38000
**Marner, W.J.**, Coal slurry letdown device, 12:36255 (RA;US)
**Marnot, P.A.**, *See* Lehn, J.M., 12:36576
**Maronde, C.P.**, Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
**Marschall, C.W.**, *See* Wilkowski, G.M., 12:36804
**Marshak, R.E.**, *See* Branco, G.C., 12:38211
**Marshall, A.C.**, RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
**Marshall, B.W. Jr.**, Experimental study of isothermal and boiling liquid jets, 12:36913 (RA;US)
**Marshall, D.B.**, Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Marshall, G.M.**, *See* Williams, M.L., 12:36777
**Marshall, T.C.**, *See* Deniz, A.V., 12:38361
**Martens, D.C.**, *See* Rappaport, B.D., 12:37840
**Marter, W.L.**, *See* King, C.M., 12:37821
**Martin, M.R.**, *See* McCardell, R.K., 12:36895
**Martin, O.S.**, Detection of DNA adducts formed from metabolites of 1-nitropyrene and 1-8-dinitropyrene in vitro, 12:37980 (RA;US)
**Martin, R.L.**, Proton accelerator for medical applications, 12:37533 (J;NL)
*See* Knapp, D.A., 12:38236
**Martinez, J.C.**, *See* Alonso, A., 12:36878
**Martinez, S.L.**, *See* Balfe, C.A., 12:37317, 12:37427
**Martinez, V.**, *See* Spore, J.W., 12:36867
**Martino, C.**, *See* Avella, R., 12:37607
**Martino, F.J.**, *See* Graczyk, D.G., 12:36782
**Martins, S.**, FDAS hardware and firmware description, liquefied gaseous fuels (LGF) data acquisition system: 1987 update, 12:36438 (R;US)
**Martz, H.**, Kalman-filter estimation of monthly US oil imports, 12:36418 (J;GB)
**Marx, C.**, *See* Hartmann, A., 12:36372, 12:36375
*See* Poege, S., 12:36373
*See* Young, F., 12:36374
**Marx, D.H.**, Reclamation of borrow pits and denuded lands: Final report, September 1, 1976 to December 31, 1985, 12:37765 (R;US)
**Marx, M.D.**, Experimental high energy physics using electromagnetic energy calorimetry: [Progress report], 12:38122 (R;US)
**Maskarinec, M.P.**, Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985, 12:37377 (R;US)
*See* Merriweather, R., 12:37372
**Mason, M.J.**, *See* Gillett, N.A., 12:37884
**Massaro, E.J.**, Pulmonary antioxidants, 12:38004 (R;US)
**Massey, M.J.**, *See* Gray, R.H., 12:36367
**Massoud, M.**, *See* Almenas, K., 12:36846
**Mata, R. Jr.**, *See* Gregory, J.J., 12:37462
**Mathews, G.J.**, *See* Bauer, R.W., 12:38247
**Mathias, C.G.T.**, *See* O'Malley, M.A., 12:37696
**Mathur, M.P.**, *See* Ekmann, J.M., 12:36350
**Matsukawa, T.**, *See* Kawabata, A., 12:37117
**Matsumoto, W.Y.**, *See* Simons, R.L., 12:37220
**Matt, D.R.**, *See* McMillen, R.T., 12:37671
**Matthews, D.L.**, X-ray laser world wide progress, 12:37488 (R;US)
**Matthews, J.**, Report on electroweak parameters, 12:38171 (RA;US)
**Mau, T.K.**, Ray tracing analysis of LH [lower hybrid] fast waves in CCT [Continuous Current Tokamak], 12:38355 (R;US)
**Mauch, W.**, *See* Butzke, R., 12:36596
**Mauderly, J.L.**, Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)
*See* Boecker, B.B., 12:37913, 12:37914, 12:37916

*See* Chen, B.T., 12:37614
*See* de Madron, E., 12:37885
*See* Gerlach, R.F., 12:37886, 12:37887
*See* Hahn, F.F., 12:37908, 12:37911
*See* Henderson, R.F., 12:37966
*See* Mewhinney, J.A., 12:37918
*See* Muggenburg, B.A., 12:37924
*See* Snipes, M.B., 12:37915
**Mauldin, G.H.,** *See* Yen, S.P.S., 12:37368
**Maxwell, C.R.,** Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)
**Maxwell, R.L.,** A performance evaluation of personnel identity verifiers, 12:36567 (R;US)
**Maya, L.,** Precursors of titanium carbonitride, 12:37311 (BA;US)
**Mayberry, M.J.,** *See* Hoffman, D.J., 12:38373
**Mayer, F.J.,** Alcator pellet evaporation data and the classical flux limit parameter, 12:38339 (R;US)
**Maylotte, D.H.,** X-ray Computed Tomography of coal: Final report, 12:36299 (R;US)
**Maziasz, P.J.,** Application of analytical electron microscopy to design of creep resistant advanced austenitic stainless steels, 12:37210 (R;US)
*See* Carolan, R.A., 12:37231
*See* Swindeman, R.W., 12:36755
**Mazumder, J.,** Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)
**Mazur, P.,** Stopping biological time: The freezing of living cells, 12:37936 (R;US)
**Mazza, M.,** Feasibility study about a National Integrated Informative System in the energy field. Results of a research on the national real demand of energetic information, 12:36980 (R;IT;In Italian)
**Mc Clanathan, L.C.,** *See* Meyers, R.A., 12:36286
**Mc Daniel, B.W.,** Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**Mc Fall, K.S.,** An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado, 12:36447 (BA;US)
**McBeth, R.,** *See* Reiter, E.R., 12:37725
**McBeth, R.L.,** *See* Hayatsu, R., 12:36294
**McCardell, R.K.,** Preliminary results of the TMI-2 core bores, 12:36895 (RA;US)
**McCarthy, D.,** Electron microscopy of single-stranded structures in the DNA of competent Haemophilus influenzae cells, 12:37871 (J;US)
**McCarty, D.L.,** Development of inductively coupled plasma spectroscopy for on-line analysis, 12:36300 (RA;US)
**McCarty, J.G.,** *See* Tong, G.T., 12:36583, 12:36584
**McCaslin, J.B.,** Moyer model approximations for point and extended beam losses, 12:37558 (J;NL)
**McCaw, P.E.,** Dendroecological analysis of a population of black gum (Nyssa sylvatic Marsh.) in southern Ontario, Canada, 12:37740 (RA;US)
**McClellan,** *See* Hahn, F.F., 12:37912
**McClellan, R.O.,** *See* Boecker, B.B., 12:37913, 12:37914, 12:37916
*See* Gillett, N.A., 12:37910
*See* Guilmette, R.A., 12:37920
*See* Hahn, F.F., 12:37908, 12:37911, 12:37923
*See* Henderson, R.F., 12:37966
*See* Mewhinney, J.A., 12:37918
*See* Muggenburg, B.A., 12:37917, 12:37919, 12:37921
*See* Snipes, M.B., 12:37915, 12:37962
**McClenahen, J.R.,** History of the chemical environment from elemental analysis of tree rings, 12:37956 (RA;US)
**McClenny, W.A.,** Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**McClung, R.W.,** *See* Cook, K.V., 12:36773
**McCold, L.N.,** *See* Schlegel, J.A., 12:37056
**McCollom, J.M.,** *See* Duever, M.J., 12:37762, 12:37832
**McConnell, B.W.,** *See* Burrage, L.M., 12:36771
**McConnell, R.,** *See* McManus, K.P., 12:37680
**McCool, J.I.,** Mechanical interactions of rough surfaces: Quarterly progress report for period December 31, 1986 to March 29, 1987, 12:37296 (R;US)
The joint effect of surface microtopography and near-surface structure on microcontact conditions: Quarterly progress report for period 31 March 1987 to 30 June 1987, 12:37295 (R;US)
**McCool, S.M.,** *See* Evans, T.E., 12:38380
**McCord, S.,** *See* Alexander, V., 12:38020
**McCormack, J.D.,** *See* Muhlestein, L.D., 12:36899
**McCormick, P.V.,** *See* Pratt, J.R., 12:37841
**McCormick, R.L.,** *See* Haynes, H.W. Jr., 12:36267
**McCoy, R.M.,** *See* Anderson, J.M., 12:36754
**McCreary, T.,** *See* Colmenares, C.A., 12:36603
**McDaniel, E.W.,** Materials used in low-level liquid waste reprocessing/ treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**McDonald, B.L.,** *See* Sanders, C.F., 12:36429
**McDonald, M.A.,** *See* Zarochak, M.F., 12:36581
**McDonald, T.G.,** A device to measure friction coefficients and contact resistance inside a scanning Auger microscope, 12:37578 (R;US)
**McElhoe, H.B.,** Remote measurement of sulfur dioxide emissions using an ultraviolet-light-sensitive video system, 12:37644 (R;US)
**McElroy, D.L.,** Testing thermal insulations with a thin-heater apparatus, 12:37023 (R;US)
**McFarlane, R.A.,** *See* Lam, J.F., 12:38091
**McFeeters, T.L.,** Permeation tubes for dynamic mass spectrometry calibration, 12:37379 (R;US)
**McGinnes, E.A. Jr.,** *See* Guyette, R., 12:38035
**McGowan, J.G.,** *See* Rini, M.J., 12:36361
**McGrail, B.P.,** Data report on static leach tests with Savannah River Laboratory defense waste glass in PBB1 brine at 90°C: Salt Repository Project, 12:36531 (R;US)
**McGuire, K.,** *See* Hill, K.W., 12:38346
**McGuire, R.K.,** *See* Stepp, J.C., 12:36892
**Mcguire, S.C.,** Statistical analysis of secondary particle distributions in relativistic nucleus-nucleus collisions, 12:38273 (R;US)
**McIlwain, T.D.,** *See* Sutter, F.C., 12:37836
**McKamey, C.G.,** Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
Development of iron aluminides for gasification systems, 12:36251 (RA;US)
**McKenna, C.,** Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)
**McKinnon, J.A.,** Sunspot numbers: 1610-1985 based on The Sunspot-Activity in the Years 1610-1960', 12:38067 (R;US)
**McKone, T.E.,** *See* Layton, D.W., 12:37584
**McLaughlin, J.B.,** *See* Azab, K.A., 12:38107
**McLaughlin, S.B.,** *See* Braeker, O.U., 12:37796
*See* Downing, D.J., 12:37858
**McLaughlin, S.I.,** *See* Sun, J.D., 12:37974
**McLuckey, S.A.,** Collision-activated dissociation of negative ions in an ion trap mass spectrometer, 12:37383 (J;US)
**McMahon, J.,** *See* Kahn, E., 12:37001
**McMahon, J.E.,** *See* Ruderman, H., 12:37097
**McMahon, T.J.,** Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon, 12:37352 (J;US)
**McManus, K.P.,** Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
**McMillen, R.T.,** Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo, 12:37671 (R;US)
**McPheeters, C.,** *See* Sawicka, B.D., 12:37009
**McPherson, R.L.,** *See* Ziegler, N.F., 12:37547
**McSorley, M.R.,** Thermal and cost comparison of six superinsulated houses and one passive solar house in the Idaho residential demonstration program, 12:37045 (RA;US)
**McVey, B.D.,** *See* Knapp, C.E., 12:37484
**Meacham, S.A.,** *See* Groenier, W.S., 12:36488
**Meadows, J.W.,** *See* Smith, D.L., 12:38233
**Means, K.H.,** *See* Johnson, E.K., 12:36347
**Mecking, B.,** *See* Gross, F., 12:37529
**Medinsky, M.A.,** Physiologically based model 1-nitropyrene metabolism, 12:37969 (RA;US)
**Mehlsen, K.,** Efficient refrigerators with small compressors, 12:37075 (R;DK;In Danish)
**Mehta, M.,** Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
**Meier, A.K.,** Energy use test procedures for appliances: A case study of Japanese refrigerators, 12:37027 (R;US)

**Meier, G.H.,** *See* Perkins, R.A., 12:37198
**Meigs, M.J.,** *See* Ziegler, N.F., 12:37547
**Meinke, R.,** *See* Bartel, W., 12:38117
**Meiss, J.D.,** *See* Chen, Q., 12:38333
**Meixel, G. Jr.,** *See* Shen, L., 12:37057
**Melillo, J.,** *See* Bernard, M.J. III, 12:37016
**Melius, J.M.,** *See* Anderson, K.E., 12:37694
**Melkus, T.G.,** An experimental study of heat of immersion of coal, 12:36292 (R;US)
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
**Mellema, S.,** Microscopic distorted-wave approximation study of low-energy nucleon scattering from /sup 89/Y, 12:38246 (J;US)
**Meller, G.,** *See* Jervered, B., 12:37109
**Menelle, A.,** Exafs and neutron scattering determination of local order in a-Si:H, 12:37330 (R;FR)
**Meng, H.Z.,** Coupling of production forecasting, fracture geometry requirements and treatment scheduling in the optimum hydraulic fracture design, 12:36391 (BA;US)
**Meng, R.L.,** *See* Hor, P.H., 12:37359
**Menicucci, D.F.,** Some applications of recent R and D experiences in the sizing of stand-alone photovoltaic power systems, 12:36652 (BA;US)
**Menzen, G.,** *See* Meyer, R.A., 12:38256
**Mercer, J.C.,** *See* Salamy, S.P., 12:36434
**Mermoud, A.,** *See* Guisan, O., 12:36703
**Merrick, J.,** *See* Watson, R.H., 12:37059
**Merrigan, M.A.,** Performance correlations for high temperature potassium heat pipes, 12:36803 (R;US)
**Merrill, B.J.,** *See* Holland, D.F., 12:38378
**Merriweather, R.,** The determination of chlorophenoxy acid herbicides by liquid chromatography using carbon-14 tracers, 12:37372 (R;US)
**Merry, M.H.,** Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
**Merten, C.W.,** Mechanical testing of carbon foam, 12:37341 (R;US)
**Merten, G.P.,** *See* Breen, S.P., 12:37013
**Meshkov, N.K.,** *See* Gilbert, T.L., 12:36501
**Messina, G.,** *See* Bizzarri, U., 12:37482
**Meuser, J.,** *See* Van Voris, P., 12:37816
**Mewhinney, J.A.,** Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 $\mu$ AMAD particles. B. Monodisperse 3.0 $\mu$m particles. XIII, 12:37918 (RA;US)
*See* Cuddihy, R.G., 12:36832
*See* Eidson, A.F., 12:37404
*See* Finch, G.L., 12:37403, 12:37617, 12:37965, 12:37972
*See* Harmsen, A.G., 12:37973
*See* Hoover, M.D., 12:37615, 12:37616
*See* Muggenburg, B.A., 12:37917
**Meyer, J.,** *See* Behrend, H.J., 12:38116
**Meyer, O.R.,** Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)
**Meyer, P.,** Towards forest stress detection with digitized color infrared imagery, 12:37778 (RA;DE)
**Meyer, R.A.,** Observation of full sets of coexisting intruder excitations in the N=58 isotones and isotopes of Zr: Evidence for alpha correlated excitations, 12:38256 (BA;DE)
**Meyer, R.E.,** *See* Ho, P.C., 12:36526
**Meyerhofer, D.D.,** *See* Levinton, F.M., 12:38357
**Meyers, R.A.,** TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Meynell, P.J.,** Survey of existing methods of biogas scrubbing and utilisation, 12:36587 (R;GB)
**Mezga, L.J.,** *See* Mitchell, M.E., 12:36960
**Michaelis, W.,** *See* Fanger, H.U., 12:37563
**Midgett, M.R.,** *See* Logan, T.J., 12:37651
**Mignogna, R.B.,** *See* Clark, A.V. Jr., 12:37264
**Miguel, M.V.,** Status of the Mexican nuclear power program, 12:36886 (RA;US)
**Mihalka, A.M.,** *See* Bulos, F., 12:37554
**Mihaly, L.,** X-ray diffraction study of the metastable charge-density-wave state of K/sub 0.3/$MoO_3$, 12:37355 (J;US)
**Mikesell, J.L.,** *See* Thorpe, A.N., 12:36312, 12:36314
**Mikkelsen, D.R.,** *See* Redi, M.H., 12:38344
**Milanovich, F.P.,** *See* Jordan, D.M., 12:37414
**Miley, H.S.,** *See* Avignone, F.T. III, 12:38248
*See* Brodzinski, R.L., 12:37569
**Mill, C.M.,** Dendrochronology and documents in Exeter, South West England, 12:38028 (RA;US)
**Millamon, P.,** Reheating furnace automatization, 12:37112 (RA;SE)
**Millar, D.M.,** *See* Klemperer, W.G., 12:37318, 12:37319
**Millar, J.D.,** Fence: where the community and the workplace meet, 12:37889 (R;US)
**Millar, M.,** Transportation energy outlook under conditions of persistently low petroleum prices, 12:36416 (R;US)
**Miller, C.L.,** SNG from coal is a viable and required future energy supply option, 12:36285 (BA;US)
**Miller, C.S.,** RELAP5/MOD2 development, 12:36866 (RA;US)
**Miller, D.G.,** *See* Rard, J.A., 12:37422
**Miller, E.J.,** The use of recovered heat for preheating air to spray driers, 12:37147 (R;NZ)
**Miller, F.J.,** Interspecies dosimetry of reactive gases, 12:37996 (R;US)
*See* Overton, J.H., 12:38001
**Miller, G.A.,** Influence of six-quark bags on electron scattering, 12:38268 (R;US)
*See* Jung, Hong, 12:38269
**Miller, J.F.,** Batteries for hybrid vehicles or other high-power applications, 12:36947 (J;GB)
**Miller, K.,** *See* Grishin, V.G., 12:38255
**Miller, K.J.,** Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
*See* Taylor, S.R., 12:36234
**Miller, R.G.,** Small-scale hydroelectric demonstration project: Reactivation of the Elk Rapids Hydroelectric Facility: Final operation and maintenance report, 12:36615 (R;US)
**Miller, R.H.,** *See* Eppley, K.R., 12:37557
**Miller, R.L.,** Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987, 12:36272 (R;US)
**Miller, S.A.,** *See* Natesan, K., 12:36351, 12:37208
**Millhollen, M.K.,** *See* Dutt, D.S., 12:36788
**Milliken, B.,** *See* Alexander J., 12:38168
**Mills, G.A.,** *See* Bischoff, K.B., 12:36597
**Milner, W.T.,** *See* Ziegler, N.F., 12:37547
**Milora, S.L.,** *See* Schuresko, D.D., 12:38372
**Minarick, J.W.,** Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**Minato, A.,** *See* Iguchi, T., 12:36859
**Minnich, S.H.,** *See* Chari, M.V.K., 12:36753
**Mintz, J.M.,** The migration and coalescence of tritium-induced helium bubbles during creep in nickel, 12:38388 (J;US)
**Mishina, K.,** *See* Nakatsuka, M., 12:37126
**Mitchell, A.W.,** *See* Arko, A.J., 12:37204
*See* Dunlap, B.D., 12:37206
**Mitchell, C.E.,** Formation of DNA adducts in mouse tissues after 1-nitropyrene administration, 12:37981 (RA;US)
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)
*See* Martin, O.S., 12:37980
**Mitchell, D.H.,** *See* Fow, C.L., 12:36527
**Mitchell, M.E.,** Executive summary of long-range environmental management plans: FY 1987-1993, 12:36960 (R;US)
**Miura, T.,** *See* Obashi, M., 12:37125
**Mobley, J.D.,** National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
**Mochrie, S.G.J.,** Thermal roughening of the copper (110) surface: An x-ray diffraction experiment, 12:37247 (J;US)
**Moe, H.J.,** *See* Kline, W.H., 12:37436
**Moe, M.K.,** A /sup 82/Se double Beta decay experiment, 12:38249 (BA;US)
**Moeller, C.P.,** *See* Hsu, Jang-Yu, 12:38337
**Moffeit, K.C.,** Status report on the polarization facility at the SLC, 12:38173 (RA;US)
**Mohamed, J.A.,** *See* Griffith, P., 12:36852
**Mohney, E.V.,** A study of Economy of Force: An analysis of varying the size of a main and secondary taskforce against a dynamic defense, 12:38400 (R;US)
**Mohr, D.,** *See* Chang, L.K., 12:36933
**Mohrenweiser, H.W.,** Molecular approaches to the detection of germinal mutations in mammalian organisms, including man, 12:38007 (R;US)
**Mola, A.,** *See* Bizzarri, U., 12:37482
**Molenaar, J.,** *See* Visser, H., 12:37954
**Molton, P.,** STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)
**Momota, H.,** *See* Berk, H.L., 12:38331
**Monkhorst, H.,** *See* Fackler, O., 12:38198

**Monserud, R.A.,** Time-series analysis applied to tree-ring series, 12:37759 (RA;US)
**Montaque, D.F.,** *See* King, C.M., 12:37821
**Montgomery, S.,** Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
**Moog, E.R.,** Magneto-optical studies of ultra-thin epitaxial films of fcc Fe on Cu(100), 12:37216 (R;US)
**Moore, C.,** *See* Bogner, J., 12:37824
*See* Dorries, T., 12:38408, 12:38409
**Moore, C.E.,** *See* Wright, R.S., 12:37637
**Moore, T.L.,** *See* Scott, D.W., 12:36546
**Mora, J.L.,** *See* Alonso, A., 12:36878
**Moradpour, A.,** *See* Lehn, J.M., 12:36576
**Moran, M.J.,** Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)
**Morawetz, E.,** Sorption - compression heat pumps and heat transformers. Technology and economics - a feasibility study, 12:37022 (R;SE;In Swedish)
**More, K.L.,** Antiphase boundaries in $\beta$-SiC thin films, 12:37289 (R;US)
**Moreno, J.B.,** *See* Lukens, L.L., 12:36657
**Moriarty, K.J.M.,** *See* Campostrini, M., 12:38155
**Morman, L.M.,** Competition: Pressures for change: Final report, 12:36996 (R;US)
**Morosin, B.,** *See* Nigrey, P.J., 12:37408
*See* Schirber, J.E., 12:37305
*See* Venturini, E.L., 12:37348
**Morris, D.G.,** *See* Olszewski, M., 12:36786
**Morris, H.E.,** *See* Thorne, B.J., 12:36403
**Morris, M.D.,** Notes on the effect of dose uncertainty, 12:37902 (R;US)
Prediction of the mortality dose-response relationship in man, 12:37901 (R;US)
*See* Lowden, R.A., 12:37301
**Morris, R.E.,** Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain, 12:37659 (R;US)
**Morrison, A.L.,** *See* Vo-Dinh, T., 12:37386
**Morrison, C.A.,** Angular-momentum theory applied to interactions in solids. Summary progress report, 12:38293 (R;US)
**Morrison, G.,** *See* Gallagher, J.S., 12:36725
**Mortimer, N.D.,** Application of the WELC well cost estimating procedure, 12:36724 (R;GB)
WELC (version 1): well cost estimating, 12:36723 (R;GB)
**Moskowitz, P.C.,** An environmental source book on the photovoltaics industry, 12:36958 (R;US)
**Moss, C.E.,** *See* Dowdy, E.J., 12:37572
**Motley, C.A.,** *See* Kuhlmeier, P.D., 12:36518
**Motley, F.,** Comparison of a TRAC calculation to the data from LSTF run SB-CL-05, 12:36849 (RA;US)
**Mott, R.E.,** New extended black oil model for simulating gas cycling in retrograde condensate reservoirs, 12:36370 (R;GB)
**Mottola, E.,** *See* Freese, K., 12:38071
**Motyka, R.J.,** *See* Liss, S.A., 12:36721
**Mougey, J.,** *See* Grunder, H.A., 12:37532
**Mowris, R.J.,** *See* Fisk, W.J., 12:37712
**Moya, J.L.,** An experimental and analytical evaluation of a Type B radioactive transport container, 12:37460 (R;US)
**Moyeda, D.K.,** *See* Cetegen, B.M., 12:36765
**Mraz, R.T.,** Performance evaluation of parallel branch and bound search with the Intel IPSC (Intel Personal Supercomputer) hypercube computer. Master's thesis, 12:38403 (R;US)
**Mroueh, U.-M.,** Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Much, M.G.,** Long-term performance of proppants under simulated reservoir conditions, 12:36400 (BA;US)
**Mueller, E.,** Applicability of Landsat-4 Thematic Mapper data for forest classifications, 12:37782 (RA;DE;In German)
**Mueller, H.,** *See* Diehl, J.F., 12:37817
*See* Joerges, B., 12:37070
**Mueller, M.,** *See* Achenbach, E., 12:36577
**Mueller, M.K.,** *See* Winkelmann, I., 12:37710
**Mueller, R.A.,** *See* Conner, W.H., 12:38021
**Mueller, W.,** *See* Lindner, R., 12:37183
**Mugge, M.,** *See* Fackler, O., 12:38198
**Muggenburg, B.A.,** Cardiopulmonary function of dogs with plutonium-induced chronic lung injury, 12:37924 (RA;US)
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 $\mu$m AMAD particles. B. Monodisperse 1.5 $\mu$m AMAD particles. C. Monodisperse 3.0 $\mu$m AMAD particles. IX, 12:37919 (RA;US)
Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII, 12:37921 (RA;US)
*See* Boecker, B.B., 12:37913, 12:37914, 12:37916
*See* Diel, J.H., 12:37922
*See* Gerlach, R.F., 12:37887
*See* Gillett, N.A., 12:37910
*See* Guilmette, R.A., 12:37906, 12:37920, 12:37930
*See* Hahn, F.F., 12:37908, 12:37912, 12:37923
*See* Haley, P.J., 12:37869
*See* Harmsen, A.G., 12:37973
*See* Mewhinney, J.A., 12:37918
*See* Snipes, M.B., 12:37915
*See* Wolff, R.K., 12:37961
**Muhlestein, L.D.,** LWR aerosol containment experiments (LACE) program summary and preliminary observations, 12:36899 (RA;US)
**Mukherjee, A.K.,** *See* Mintz, J.M., 12:38388
**Mulera, T.,** *See* Conti, M., 12:37573
**Mulholland, G.P.,** *See* Maxwell, C.R., 12:36673
**Mulholland, J.A.,** Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)
*See* Srivastava, R.K., 12:37522
**Mullen, G.,** *See* Paik, C.Y., 12:36853
**Muller, E.S.,** Material damping measurements of 2-d carbon-carbon composite beams. Master's thesis, 12:37324 (R;US)
**Mullin, J.W.,** *See* Beiny, D.H., 12:37417
**Munger, A.C.,** The application of variable explosive chamber testing to actuator testing, 12:37583 (R;US)
**Munis, R.,** *See* McKenna, C., 12:37015
**Munno, C.J.,** *See* Almenas, K., 12:36846
**Munno, F.J.,** *See* Almenas, K., 12:36846
**Munoz, J.D.,** *See* Peterson, G., 12:36377
*See* Ray, R.M., 12:36376
**Murakami, M.,** *See* Lyon, J.F., 12:38368
**Muranaka, K.,** *See* Kawabata, A., 12:37117
**Murao, Y.,** Development of reflood model at JAERI, 12:36861 (RA;US)
*See* Akimoto, H., 12:36887
*See* Iguchi, T., 12:36858, 12:36859
*See* Iwamura, T., 12:36860
**Murata, K.K.,** Integrated ex-vessel source term analysis with the CONTAIN 1.1 computer code, 12:36901 (RA;US)
**Murdie, N.,** *See* Hippo, E.J., 12:36239
**Murdock, S.H.,** The socioeconomic impacts of high-level nuclear waste facility siting, 12:36544 (BA;US)
**Murphy, B.L.,** *See* Kenoyer, J.L., 12:36555
**Murphy, K.D.,** *See* Magnani, N.J., 12:36944
**Murphy, L.M.,** Moderate axisymmetric deformations of optical membrane surfaces, 12:36707 (J;US)
Moderate to large axisymmetric deformations of optical membrane surfaces, 12:36713 (BA;US)
**Murray, S.A.,** *See* Bruggink, D.J., 12:37856
**Murtagh, M.J.,** Review of the Brookhaven neutrino workshop, 12:38113 (R;US)
*See* Ahrens, L.A., 12:38150
*See* Baker, N.J., 12:38243
**Muscatello, A.C.,** Aqueous methods for recovery of plutonium from pyrochemical residues, 12:36490 (R;US)
**Muto, S.,** *See* Ebihara, M., 12:37115
**Myer, L.R.,** Permeability of shale at elevated temperature and pressure: Test methodology and preliminary results, 12:36522 (R;US)
*See* Pyrack-Nolte, L.J., 12:38043
**Myer, R.C.,** Modeling of ICRH experiments in the Tara tandem mirror, 12:38327 (R;US)
**Myers, D.A.,** *See* Oberlander, P.L., 12:37847
**Myronuk, R.S.,** *See* Jozsa, L.A., 12:38031

## N

**Naceur, K.B.,** Mechanisms controlling fracture height growth in layered media, 12:36392 (BA;US)
*See* Thiercelin, M., 12:36394
**Nadel, S.M.,** Fuel savings analysis: house doctoring and storm windows, 12:37046 (RA;US)
**Nagao, S.,** Calmodulin and calmodulin binding proteins in amphibian rod outer segments, 12:37879 (J;US)
**Nagata, I.,** *See* Tamura, K., 12:37419
**Nagler, S.E.,** X-ray scattering studies of non-equilibrium ordering processes: Progress report, August 1, 1986-October 31, 1987, 12:37217 (R;US)
**Nagy, P.B.,** Surface roughness effects in porosity assessment by ultrasonic

attenuation spectroscopy, 12:37263 (BA;US)
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**Najafi, B.,** *See* Theofanous, T.G., 12:36914
**Nakagawa, C.H.,** Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation), 12:36590 (R;US)
**Nakahara, S.,** *See* Rudman, D.A., 12:37283
**Nakamori, N.,** *See* Tsuge, A., 12:36917
**Nakamura, H.,** *See* Tasaka, K., 12:36848
**Nakatsuka, M.,** Sophisticated reheating furnace with outstanding combustion control for high quality and energy efficiency, 12:37126 (RA;SE)
**Nakhaie, H.,** *See* Boehm, R., 12:36663
**Nakhala, G.F.,** *See* Suidan, M.T., 12:36327
**Nallasamy, M.,** Prediction of recirculation zones in isothermal coaxial jet flows relevant to combustors, 12:37494 (R;US)
**Namba, H.,** *See* Tsunoyama, S., 12:36877
**Namenyi, J.,** *See* Chen, B.T., 12:37614
**Namyslowski, J.M.,** Nonperturbative extension of the light-front QCD, 12:38267 (R;US)
**Narain, N.K.,** Disposable catalysts in coal liquefaction, 12:36282 (BA;NL)
*See* Tischer, R.E., 12:36279
**Narasimhan, T.N.,** MINC [Multiple Interacting Continua]: An approach for analyzing transport in strongly heterogeneous systems, 12:38037 (R;US)
**Narayanan, T.V.,** *See* Carli, G., 12:36664
**Naroska, B.,** *See* Bartel, W., 12:38117
**Nash, T.,** Study of charm production mechanisms at the Fermilab Tagged Photon Spectrometer: γBe yields D anti D x and γA yields psi x, 12:38125 (R;US)
**Natesan, K.,** An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
Materials for FBC [fluidized-bed combustion] air heater applications, 12:36351 (R;US)
**Nau, D.,** Experiments on alternatives to minimax, 12:38414 (J;US)
**Ne'eman, Y.,** Double covering of diffeomorphisms for superstrings in generic curved space, 12:38227 (BA;US)
**Near, C.,** *See* Tsai, Y., 12:37297
**Neeper, D.A.,** Evaluation of materials by the energy yield of an active system, 12:36684 (R;US)
**Nelson, B.D.,** Minnesota energy efficient house research project, 12:37047 (RA;US)
**Nelson, D.A.,** *See* Theander, O., 12:37406
**Nelson, D.J.,** Two-dimensional, analysis and performance of a natural convection glazed collector/ regenerator, 12:36699 (BA;US)
**Nelson, G.,** *See* Shen, L., 12:37057
**Nelson, G.D.,** Results of construction quality inspections of 25 low-energy Minnesota homes, 12:37048 (RA;US)
Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings, 12:37049 (RA;US)
*See* Nelson, B.D., 12:37047
**Nelson, G.R.,** Applications of thermography, 12:37050 (RA;US)
**Nelson, M.A.,** *See* Layton, D.W., 12:37584
**Nelson, M.D.,** *See* Nicholson, J.K., 12:37609
**Nelson, P.A.,** *See* Kaun, T.D., 12:36941
**Nelson, R.A.,** *See* Spore, J.W., 12:36867
**Nelson, R.E.,** *See* Graczyk, D.G., 12:36782
**Nes, H.,** Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**Neskovic-acute-accent, N.,** Ion channeling and catastrophe theory, 12:37248 (J;US)
**Nester, E.W.,** *See* Cangelosi, G.A., 12:37865
**Nestor, C.W. Jr.,** *See* Raman, S., 12:38279
**Neta, P.,** Pulse radiolytic studies of inter- and intramolecular electron transfer processes: Progress report, 12:37434 (R;US)
**Netland, K.,** Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)
**Neureither, B.,** Instrument for the quasi-continuous determination of the atmospheric soot content, 12:37525 (R;DE;In German)
**Nevalainen, A.,** *See* Pellikka, M., 12:37085, 12:37090
**Neville, J.,** Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**Nevitt, R.M.,** Energy savings in 12 multifamily buildings retrofitted under a shared savings program, 12:37051 (RA;US)
**Newkirk, G.,** *See* Arnaud, J., 12:38064
**Newkirk, T.M.,** *See* Kirkpatrick, D.T., 12:37982
**Newnham, R.E.,** *See* Shiau, S.M., 12:37361
**Newsom, P.C.,** Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)
**Newton, G.J.,** Evaluation of an L-shell X-ray based continuous air monitor for airborne plutonium for use in the waste isolation pilot plant, 12:37716 (RA;US)
*See* Cuddihy, R.G., 12:36832
*See* Seiler, F.A., 12:37714, 12:37715
*See* Su, Y.F., 12:37713
*See* Yeh, H.C., 12:37619
**Neynaber, R.H.,** Low-energy collisions of excited atoms. Final report, 1 May 1984-30 April 1985, 12:38090 (R;US)
**Ng, E.K.,** Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)
**Ng, K.W.,** Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
**Nichols, G.B.,** *See* DuBard, J.L., 12:37610
**Nicholson, J.K.,** Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report, 12:37609 (R;US)
**Nicinski, T.,** *See* Heinicke, P., 12:38410
**Niederer, M.,** *See* Kontic, R., 12:37602
**Nielsen, C.S.,** Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**Nielsen, M.G.,** Design of agitation systems in Bingham slurries by pilot simulation, 12:36511 (R;US)
**Nielsen, V.,** *See* Kristiansen, P.S., 12:37149
**Nieuwoudt, J.C.,** Transport properties of isobutane, 12:37416 (J;US)
**Nigrey, P.J.,** Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Nilssen, T.,** Progress curves for North Sea platform projects, 12:36415 (R;NO)
**Nilsson, B.,** Thermal oxidation of waste from wet-dry flue gas desulfurization and reuse of the final product, 12:36766 (R;SE;In Swedish, English and German)
**Nimick, F.B.,** Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project, 12:36539 (R;US)
**Nippel, C.,** *See* Kontic, R., 12:37602
**Nishizawa, Masahisa,** Method of inventorying and evaluating the state of water and soil conservation in artificial forest, 12:37732 (RA;DE)
**Nissilae, M.,** *See* Arpiainen, V., 12:36278
**Nitschke, J.M.,** *See* Toth, K.S., 12:38253
**Nixon, R.D.,** Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide, 12:37281 (R;US)
**Noble, R.J.,** Beamstrahlung from colliding electron-positron beams with negligible disruption, 12:37545 (J;NL)
**Nolen, S.L.,** Real-time monitoring of a hazardous-waste incinerator with a mobile laboratory. Report for December 1986-January 1987, 12:37157 (R;US)
**Nordfjell, T.,** *See* Danfors, B., 12:37150
**Nordi, R.T.,** *See* Hattrup, M.P., 12:37080
**Nordin, C.,** *See* Hoegberg, E., 12:37043
**Norman, M.R.,** Mass renormalizations and superconductivity in heavy-fermion $UPt_3$, 12:37252 (J;US)
**Norman, R.,** The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
**Norman, V.S.,** *See* Trimble, J.L., 12:37859
**Norris, A.E.,** Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)
**Noshkin, V.E.,** Concentrations of radionuclides in fish collected from Bikini Atoll between 1977 and 1984, 12:37852 (R;US)
**Nourbakhsh, H.,** *See* Khatib-Rahbar, M., 12:36905
**Novack, M.E.,** Fluid friction control valve, 12:36248 (RA;US)
**Novich, C.M.,** *See* Van Voris, P., 12:37816
**Nowlen, S.P.,** Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)
Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review, 12:36923 (R;US)

**Noyes, H.P.**, Measurement by phase severance, 12:38309 (R;US)
On the discrete reconciliation of relativity and quantum mechanics, 12:38310 (R;US)
**Nydick, S.E.**, Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling, 12:37131 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 4.0, Single-cylinder engine tests, 12:37132 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 6.0 Determination of accurate heat release diagrams and mechanical efficiency, 12:37133 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)
**Nye, A.C.**, *See* Pounds, J.G., 12:37937
**Nye, C.J.**, *See* Liss, S.A., 12:36721
**Nystad, A.N.**, Petroleum taxes and optimal resource recovery, 12:36414 (R;NO)
Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)

## O

**O'Connell, R.F.**, Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986, 12:38297 (R;US)
**O'Connell, W.J.**, Sensitivity of piping seismic responses to input factors, 12:36931 (R;US)
*See* George, L.L., 12:36932
**O'Donnell, F.R.**, *See* Kocher, D.C., 12:36525
**O'Gallagher, J.**, *See* Suresh, D., 12:36710
**O'Hara, J.B.**, Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**O'Leary, L.A.**, *See* Schlegel, J.A., 12:37056
**O'Mahoney, R.**, *See* Swinnerton, D., 12:36883
**O'Malley, M.A.**, Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
**O'Neill, R.V.**, *See* Bartell, S.M., 12:37833
**O'Shaughnessy, K.**, Monte Carlo models for top production, 12:38175 (RA;US)
**Obashi, M.**, Optimum design and energy saving measures of a new billet mill furnace, 12:37125 (RA;SE)
**Oberdorfer, J.A.**, *See* Buddemeier, R.W., 12:37853
**Oberlander, P.L.**, Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington, 12:37847 (J;US)
**Oblath, S.B.**, Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste, 12:36510 (R;US)
**Odar, F.**, Code uncertainty quantification, 12:36879 (RA;US)
**Odum, H.T.**, *See* Brown, M.T., 12:37827
**Oester, B.**, *See* Scherrer, H.U., 12:37779
**Oezerler, M.**, *See* Hartmann, A., 12:36372, 12:36375
**Offenhaeuser, F.**, Kinetic model for the vibrational energy exchange in flowing molecular gas mixtures. Ph.D. Thesis, 12:37491 (TG;US)
**Ogata, J.**, *See* Tsuge, A., 12:36917
**Ogawa, K.**, *See* Voet, D., 12:37861
**Oh, P.**, Curvature of Super Diff($S^1$)/$S^1$, 12:38216 (R;US)
**Ohnuki, A.**, *See* Akimoto, H., 12:36887
*See* Iwamura, T., 12:36860
*See* Murao, Y., 12:36861
**Ohyabu, N.**, *See* Evans, T.E., 12:38380
**Ojala, M.**, *See* Jaemsae, S., 12:37091
**Okaye, C.O.**, *See* Salamy, S.P., 12:36434
**Okoye, C.O.**, *See* Yost, A.B. II, 12:36451
**Okubo, S.**, General Dynkin indices and their applications, 12:38213 (BA;US)
**Okubo, T.**, *See* Iguchi, T., 12:36858
*See* Iwamura, T., 12:36860
*See* Murao, Y., 12:36861
**Oldenborg, R.C.**, Optical detection of alkali compounds, 12:36302 (RA;US)
**Olin, M.**, *See* Raunemaa, T., 12:37094
**Oliveira, G.C.**, *See* Pereira, M.V.F., 12:36770
**Olsen, C.S.**, *See* Akers, D.W., 12:36894
**Olsen, J.A.**, *See* Fisher, R.A., 12:37227, 12:37228
**Olsen, L.C.**, Graded-bandgap solar cells. Annual report, 1 September 1985-31 August 1986, 12:36620 (R;US)
**Olson, C.G.**, *See* Arko, A.J., 12:37204
**Olson, E.S.**, *See* Schobert, H.H., 12:36323
**Olsson, M.G.**, *See* Osypowski, E., 12:38312
**Olszewski, M.**, Assessment of energy storage concepts for use in pulsed space power systems, 12:36786 (R;US)
**Ondo, J.L.**, *See* John, W., 12:37667
**Ondracek, G.**, Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
*See* Jauch, U., 12:37299
**Onoe, M.**, How to observe tree-ring without really cutting, 12:38034 (RA;US)
**Onuki, A.**, *See* Iguchi, T., 12:36859
**Opelka, J.H.**, *See* Habegger, L.J., 12:36799
**Oren, R.**, *See* Waring, R.H., 12:37733
**Origoni, G.**, *See* de Meulemeester, A., 12:37647
**Ornellas, D.**, An evaluation of three temperature controllers for a +-0.002°C application, 12:37467 (R;US)
**Orr, R.S.**, System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1, 12:37580 (R;US)
**Ortega, A.**, Research in lost circulation control for geothermal wells, 12:36726 (R;US)
**Ortiz, M.E.**, *See* Chan, Y., 12:38261
**Ortiz, S.**, Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
**Osakabe, M.**, *See* Tasaka, K., 12:36848
**Osborn, J.E.**, *See* Szymczak, W.G., 12:38104
**Osborne, M.C.**, Resolving the radon problem in Clinton, New Jersey houses. Published paper, April-December 1986, 12:37718 (R;US)
*See* Brennan, T., 12:37719
**Osman, Y.A.**, *See* Conway, T., 12:37867
**Osterwald, C.R.**, *See* Emery, K.A., 12:36643
**Osthoff, A.**, *See* Aderholz, M., 12:37565
**Ostrowski, P. Jr.**, *See* Bruggink, D.J., 12:37856
**Osudar, J.**, *See* Graczyk, D.G., 12:36782
**Osypowski, E.**, Isynchronous motion in classical mechanics, 12:38312 (J;US)
**Ottesen, D.K.**, In situ real-time analysis of particulates, 12:36355 (RA;US)
**Oural, C.R.**, Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
**Overbey, W.K.**, *See* Yost, A.B. II, 12:36451
**Overseth, O.E.**, *See* Sullivan, M.W., 12:38151
**Overton, J.H.**, Modeling ozone absorption in the lower respiratory tract, 12:38001 (R;US)
*See* Miller, F.J., 12:37996
**Owen, E.L.**, *See* Anderson, J.M., 12:36754
**Owens, T.L.**, Tests of a high-power folded waveguide coupler for ICRF heating, 12:38371 (R;US)
*See* Swain, D.W., 12:38374
**Ozarski, R.G.**, *See* Manes, K.R., 12:37486
**Ozdemir, B.**, *See* Hewitt, H.C. Jr., 12:36696
**Ozga, D.A.**, *See* Cangelosi, G.A., 12:37865

## P

**Pacca, J.L.A.**, *See* Villani, A., 12:38395
**Pacheco, M.A.**, A two-stage bench scale catalytic reactor system, 12:36290 (B;US)
**Packer, S.**, A TEM [transmission electron microscopy] study of rhodium on GaAs: Reactions and morphology, 12:37514 (R;US)
**Paez, T.L.**, Random control at $n^2$ points using n shakers, 12:37508 (R;US)
**Paffrath, D.**, *See* Neureither, B., 12:37525
**Page, R.H.**, Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams, 12:38096 (R;US)
**Pagnier, M.**, A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing, 12:36682 (R;US)
**Paik, C.Y.**, Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)
**Palazzolo, M.A.**, *See* Dykes, R.M., 12:37158
**Palmer, A.J.**, *See* Lam, J.F., 12:38091
**Palmer, R.B.**, *See* Baker, N.J., 12:38243
**Palmer, R.N.**, *See* Lettenmaier, D.P., 12:36610

**Palmiter, L.,** Measured performance of superinsulated homes in Montana: second report, 12:37052 (RA;US)
**Palz, W.,** Solar energy: European research and development. Contractors' catalogue 1984, 12:36619 (R;XE)
**Panchal, C.B.,** Simultaneous production of desalinated water and power using a hybrid-cycle OTEC plant, 12:36678 (J;US)
**Pane, A.J.,** *See* Leider, H.R., 12:37585
**Panson, A.J.,** *See* Ekin, J.W., 12:37288
**Papamichael, K.M.,** *See* Selkowitz, S.E., 12:37072
**Paradies, M.W.,** Using operating experience and a cause coding tree to identify improvements for nuclear process control, 12:36825 (R;US)
**Parent, C.R.,** *See* Friedman, P.S., 12:36705
**Parisi, W.A.,** *See* Howell, R.W., 12:36439
**Park, C.,** *See* Khatib-Rahbar, M., 12:36905
**Park, S.M.,** Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**Parke, S.J.,** Resonant neutrino oscillations, 12:38193 (RA;US)
**Parker, D.S.,** Generalized method to estimate the thermal performance of earth contact walls and floors, 12:37053 (RA;US)
**Parker, J.,** Synthesis of organometallic compounds: Final technical report, 12:37336 (R;US)
*See* Brosch, G., 12:37099
**Parker, J.K.,** *See* Mayer, F.J., 12:38339
**Parker, M.L.,** Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide, 12:37953 (RA;US)
**Parkin, G.F.,** *See* Bhattacharya, S.K., 12:36588
**Parkinson, B.A.,** *See* Ryan, M.A., 12:37356
**Parkinson, W.J.,** Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)
*See* Gac, F.D., 12:37300
**Parmentier, G.,** *See* Vassout, P., 12:38015
**Parr, P.D.,** Resource Management Plan for the Oak Ridge Reservation: Volume 23, Oak Ridge National Environmental Research Park, Research Sites, and State Natural Areas, 12:36963 (R;US)
**Parsons, R.S.,** Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)
**Partom, Y.,** The shell model for hot-spot ignition, 12:37581 (R;US)
**Patrick, W.P.,** Flowfield measurements in a separated and reattached flat plate turbulent boundary layer. Final report, 12:37496 (R;US)
**Patrinos, A.A.N.,** Episodic coincident air-quality and precipitation measurements in an urban setting, 12:37664 (R;US)
**Paulos, S.K.,** *See* Conlin, F., 12:37032
**Paulsen, G.A.,** *See* Bonzon, L.L., 12:36918
**Paur, R.J.,** *See* McClenny, W.A., 12:37665
**Pawliak, T.,** *See* Grishin, V.G., 12:38255
**Payette, S.,** *See* Filion, L., 12:37741
**Payne, D.A.,** *See* Budd, K.D., 12:37309
*See* Schwartz, R.W., 12:37314
**Payne, M.J.,** Raman spectroscopic studies of titanium alkoxides using UV excitation, 12:37426 (BA;US)
**Payne, R.,** *See* Cetegen, B.M., 12:36765
**Peacock, H.B.,** *See* Thompson, A.C., 12:37218
**Pearson, K.G.,** *See* Swinnerton, D., 12:36883
**Pechan, E.H.,** National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**Peck, C.,** *See* Banks, T., 12:38181
**Pedersen, N.F.,** *See* Wiesenfeld, K., 12:37470
**Peebles, D.E.,** *See* McDonald, T.G., 12:37578
**Peebles, H.C.,** *See* McDonald, T.G., 12:37578
**Peehs, M.,** *See* Kanzleiter, T., 12:36902
**Peeler, J.W.,** *See* Quarles, P., 12:37681
**Peirano, W.B.,** *See* Reisman, D.J., 12:37990
**Pellegrin, J.L.,** Beam trajectory acquisition system for the arcs of the Stanford Linear Collider, 12:37555 (R;US)
**Pellikka, M.,** Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Pellin, M.J.,** Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals, 12:38296 (R;US)
**Peltola, T.,** *See* Huhtinen, M., 12:36363
**Pendergraph, C.,** *See* Mulholland, J.A., 12:37649
**Penfield, P.,** Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987, 12:38402 (R;US)
**Pennline, H.W.,** Activation and promotion studies in a mixed slurry reactor with an iron-manganese Fischer-Tropsch catalyst, 12:37412 (J;US)
**Penny, G.S.,** *See* Much, M.G., 12:36400
**Pennycook, S.J.,** *See* Christen, D.K., 12:37291
**Penrose, W.R.,** *See* Stetter, J.R., 12:37707
**Peoples, J.,** *See* Diebold, R., 12:37536
**Pepelnik, R.,** *See* Fanger, H.U., 12:37563
**Peramunage, D.,** *See* Yuan, R.K., 12:36642
**Percival, I.C.,** *See* Chen, Q., 12:38333
**Pereira, M.V.F.,** Composite generation-transmission expansion planning: Final report, 12:36770 (R;US)
**Perez-Mendez, V.,** *See* Conti, M., 12:37573
**Perkins, M.T.,** *See* Calo, J.M., 12:36271
**Perkins, R.A.,** Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Annual technical report, November 1985-January 1986, 12:37198 (R;US)
**Perl, M.L.,** Small visible energy events and close-mass lepton pairs, 12:38178 (RA;US)
**Perlmutter, D.D.,** *See* Chang, Y., 12:36284
*See* Chi, W.K., 12:36287
**Perovic-acute-accent, B.,** *See* Neskovic-acute-accent, N., 12:37248
**Perry, T.P.A.,** *See* Mitchell, M.E., 12:36960
**Persad, C.,** High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)
**Pertmer, G.A.,** *See* Almenas, K., 12:36846
**Pervushin, V.N.,** *See* Kalinovskij, Yu.L., 12:38206, 12:38208
**Peryt, W.,** *See* Grishin, V.G., 12:38255
**Peshkin, M.,** *See* Lipkin, H.J., 12:38317
**Peskin, M.E.,** Introduction to string and superstring theory II, 12:38223 (R;US)
Superstring spectroscopy, 12:38222 (RA;US)
**Peters, B.B.,** *See* Gibson, M.W., 12:36532
**Peters, E.,** *See* Karvelas, D., 12:37159
**Peters, K.A.,** *See* Weiner, E.O., 12:36831
**Peters, S.W.,** *See* Horacek, D.R., 12:36249, 12:37456
**Peters, W.C.,** A centralized MHD data base, 12:37006 (BA;US)
**Petersen, A.,** Comparison of multihadronic event generators, 12:38186 (RA;US)
**Peterson, D.L.,** Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California, 12:37946 (RA;US)
**Peterson, E.J.,** *See* Parkinson, W.J., 12:36472
**Peterson, E.W.,** *See* Stormont, J.C., 12:36540
**Peterson, G.,** Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes, 12:36377 (R;US)
**Peterson, G.A.,** *See* Hicks, R.S., 12:38240
**Peterson, G.P.,** Thermal contact resistance in waste heat recovery systems, 12:37152 (BA;US)
**Peterson, K.,** *See* Cheng, Y.S., 12:37613
**Peterson, K.M.,** *See* Hashemian, H.M., 12:36774
**Peterson, K.P.,** *See* Howell, R.W., 12:36439
**Peterson, M.W.,** *See* Ryan, M.A., 12:37356
**Petersson, M.,** *See* Burfield, L.J., 12:37119
**Pethick, C.J.,** Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
**Petler, J.S.,** *See* Mellema, S., 12:38246
**Petney, S.V,** *See* Labreche, D.A., 12:38046
**Petravick, D.,** *See* Heinicke, P., 12:38410
**Petrovich, F.,** *See* Mellema, S., 12:38246
*See* Rapaport, J., 12:38241
**Petrucci, M.,** Surface quality with oxygen control of furnace atmosphere, 12:37215 (RA;SE)
**Petry, H.,** Applications of energy storage systems in lifting gears, 12:36936 (R;DE;In German)
**Pfeffer, J.T.,** *See* Suidan, M.T., 12:36327
**Pfeffer, N.,** *See* Kumar, S., 12:36762
**Pfeiffer, P.A.,** Nuclear waste package fabricated from concrete, 12:36503 (R;US)
**Pfeifle, T.W.,** Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand, 12:36535 (R;US)
**Pfender, E.,** *See* Young, R.M., 12:37445
**Phadke, A.G.,** Impact of adaptive protection on power system control, 12:36769 (R;US)
*See* Horowitz, S.H., 12:36768
*See* Thorp, J.S., 12:37511

**Phillips, A.M.,** Successful field application of high-temperature rheology of CO/ sub 2/ foam fracturing fluids, 12:36448 (BA;US)
**Phillips, G.C.,** High energy physics: Progress report, 12:38121 (R;US)
**Phillips, H.L.,** *See* Biallas, G., 12:37548
**Phillips, L.,** *See* Brindza, P., 12:37549
**Phillips, N.E.,** *See* Fisher, R.A., 12:37226, 12:37227, 12:37228
**Phillips, P.H.,** *See* Boshier, J.F., 12:36952
**Phillips, T.T.,** *See* Parkinson, W.J., 12:36472
**Philpot, R.M.,** *See* Sabourin, P.J., 12:37976
**Phinney, N.,** *See* Thompson, K.A., 12:37556
**Phutela, R.C.,** Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Picardi, L.,** *See* Bizzarri, U., 12:37482
**Pickrell, J.A.,** Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts, 12:37971 (RA;US)
*See* Boecker, B.B., 12:37913, 12:37916
*See* Hahn, F.F., 12:37908, 12:37911
*See* Kirkpatrick, D.T., 12:37975
*See* Mauderly, J.L., 12:36476
*See* Rothenberg, S.J., 12:37618
*See* Snipes, M.B., 12:37915
*See* Sun, J.D., 12:37974
**Picraux, S.T.,** *See* Sorensen, N.R., 12:37258
**Pierrard, H.,** *See* Biau, G., 12:37116
**Piest-up, M.A.,** *See* Moran, M.J., 12:37509
**Piet, S.J.,** *See* Holland, D.F., 12:38378
**Pietrzak, R.F.,** *See* Dougherty, D.R., 12:36500
**Piette, M.A.,** Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues, 12:37073 (R;US)
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)
**Pignone, C.,** *See* Kahn, E., 12:37001
**Pilch, M.,** *See* Tarbell, W.W., 12:36910
**Piller, B.,** *See* Choquard, Ph., 12:38304
**Pin, F.G.,** *See* Goldstein, M., 12:36808
**Pinchera, G.C.,** *See* Malatini, S., 12:37857
**Pindera, M.J.,** Mechanical and thermal characterization of unidirectional aramid/epoxy. Final report, November 1985-December 1986, 12:37329 (R;US)
**Pines, D.,** *See* Pethick, C.J., 12:38306
**Pinto, L.M.V.G.,** *See* Pereira, M.V.F., 12:36770
**Piper, S.,** NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**Piplies, L.,** *See* Addabbo, C., 12:36842
**Pitkaenen, E.,** *See* Pellikka, M., 12:37085, 12:37090
**Pitner, A.L.,** *See* Weber, E.T., 12:36820
**Pitrolo, A.A.,** Opening remarks: instrumentation, components, and materials contractors meeting, 12:36242 (RA;US)
**Pitzer, K.S.,** *See* Phutela, R.C., 12:37421
**Plaggmier, M.M.,** *See* Muggenburg, B.A., 12:37924
**Plagnol, E.,** *See* Chan, Y., 12:38261
**Planchon, H.P.,** *See* Chang, L.K., 12:36933
**Plank, H.,** *See* Riegel, B., 12:36864
**Plothow-Besch, H.,** Latest results from the UA2 experiment, 12:38132 (RA;US)
**Plourde, B.E.,** Electro-optical modulator for an electro-optically modulated laser, 12:37489 (P;US)
**Plum, M.A.,** *See* Hicks, R.S., 12:38240
**Plut, T.A.,** *See* Hughes, R.C., 12:37519
**Pluta, J.,** *See* Grishin, V.G., 12:38255
**Podolski, W.F.,** *See* Natesan, K., 12:36351, 12:37208
**Podosek, F.A.,** *See* Hudson, G.B., 12:38070
**Poege, S.,** Investigation of temperature stability of bore flushing liquids based on water, 12:36373 (RA;DE;In German)
*See* Hartmann, A., 12:36375
**Poeppel, R.B.,** *See* Easler, T.E., 12:37293
*See* Goretta, K.C., 12:37306
**Pollanschuetz, J.,** Austrian survey on forest condition, 12:37790 (RA;DE;In German)
**Pollard, B.,** Effects of minor elements on the welding characteristics of stainless steel, 12:37236 (RA;US)
**Pomphrey, N.,** *See* Manickam, J., 12:38348
**Pons, S.,** *See* Sammells, A.F., 12:36578
**Pontasch, K.W.,** *See* Pratt, J.R., 12:37841
**Pope, A.A.,** Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
**Pope, G.A.,** Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)
**Pope, L.E.,** *See* Lloyd, J.N., 12:37238
*See* McDonald, T.G., 12:37578
**Pordes, R.,** *See* Dorries, T., 12:38408, 12:38409
*See* Heinicke, P., 12:38410
**Porter, F.,** Toponium physics with a small data sample, 12:38179 (RA;US)
**Poso, S.,** Towards the integrated use of satellite data for forest inventories. A methodological perspective, 12:37800 (RA;DE)
**Postma, A.K.,** *See* Henrie, J.O., 12:36829
**Potter, T.F.,** Recent results: SERI's development of advanced glazings, 12:37054 (RA;US)
**Pouliot, J.,** *See* Chan, Y., 12:38261
**Poulson, R.E.,** Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Pounds, J.G.,** Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)
*See* Gordon, B.M., 12:37873
**Pounds, L.R.,** *See* Parr, P.D., 12:36963
**Povirk, C.A.,** *See* Atlas, H., 12:36360
**Powell, J.R.,** *See* Horn, F.L., 12:36780
*See* Lazareth, O.W., 12:36779
**Powers, T.J.,** *See* Shepherd, P.B., 12:37139
**Prado, L.R.,** An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)
**Prater, J.T.,** Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)
**Pratt, J.R.,** Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**Prausnitz, J.M.,** *See* Chou, G.F., 12:36464
**Prensky, S.E.,** *See* Charpentier, R.R., 12:36431
**Price, C.W.,** Anisotropic Schmid factors in constrained systems, 12:37260 (J;US)
Estimates of incubation and completion times in recrystallization, 12:37259 (J;US)
**Price, D.L.,** *See* Saboungi, M., 12:37246
**Price, J.B.,** *See* Gac, F.D., 12:37300
**Price, L.E.,** *See* Ayres, D.S., 12:37575
**Priedhorsky, W.C.,** *See* Haberl, F., 12:38073
**Prindle, N.K.,** Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project, 12:37822 (R;US)
**Pritchard, P.C.H.,** Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
**Privette, J.,** *See* Zaromb, S., 12:37957
**Proctor, A.E.,** Implementation of the pulse injection technique for dead-time and pileup corrections in gamma spectroscopy suitable for automated systems, 12:37570 (J;NL)
**Pruden, M.A.,** Fire frequency and old trees in the Southern Canadian Rockies, 12:37748 (RA;US)
**Pruess, K.,** *See* Narasimhan, T.N., 12:38037
**Puckett, D.A.,** Gamma tomography as an aid to experimental enhanced oil recovery, 12:36369 (R;GB)
**Puehlhofer, F.,** *See* Sohlbach, H., 12:38260
**Pulsipher, B.A.,** Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste, 12:36528 (R;US)
**Purdom, P.,** *See* Nau, D., 12:38414
**Purohit, M.V.,** Experimental results on heavy flavour hadro- and photo-production, 12:38126 (R;US)
**Puvanesarajah, V.,** *See* Cangelosi, G.A., 12:37865
**Pyrack-Nolte, L.J.,** Hydraulic and mechanical properties of natural fractures in low-permeability rock, 12:38043 (R;US)

## Q

**Quarles, P.,** Handbook for the review of excess emission reports. Final report, 12:37681 (R;US)
**Querol, A.,** *See* Alonso, A., 12:36878
**Quest, K.B.,** *See* Tokar, R.L., 12:38364
**Quindos, L.S.,** *See* Newton, G.J., 12:37716
**Quintana, G.R.,** *See* Ortiz, S., 12:36564
**Quintiliani, G.,** *See* Petrucci, M., 12:37215

# R


**Rabideau, P.W.,** Studies of metal ammonia interactions with aromatic substrates: Progress report for the period February 1, 1987 to December 31, 1987, 12:37394 (R;US)

**Radosevich, L.G.,** An analysis of power production performance for solar one, the 10 MWe Solar Thermal Central Receiver Pilot Plant, 12:36659 (R;US)

**Raghavachari, K.,** Structure, stability, and fragmentation of small carbon clusters, 12:37409 (J;US)

**Raja, S.,** *See* Mazumder, J., 12:37201

**Rajamani, K.,** *See* Hu, W., 12:36237

**Raju, P.S.,** *See* Teotia, A.P.S., 12:37018, 12:37024

**Ram, A.K.,** *See* Fuchs, V., 12:38328

**Ramachandran, N.,** Modelling, simulation and optimization of heating of metal in reheating furnaces, 12:37108 (RA;SE)

**Ramage, W.E.,** The comparative economics of thermal recovery projects, 12:36382 (R;US)

**Raman, S.,** Global set of quadrupole deformation parameters for even-even nuclei, 12:38279 (BA;DE)
*See* Inn, K.G.W., 12:37577

**Ramesh, R.,** Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**Ramey, H.J. Jr.,** *See* Ramage, W.E., 12:36382

**Ramey, J.O.,** *See* Sales, B.C., 12:37331

**Ramond, P.,** *See* Harari, D., 12:38217
*See* Oh, P., 12:38216

**Ramos, J.J.,** *See* Spong, D.A., 12:38323

**Ramsey, G.H.,** *See* Sparks, L.E., 12:37668

**Rangelov, L.,** Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report], 12:37065 (R;US)

**Ranjan, R.,** On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)

**Rankin, P.,** Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)

**Rantala, E.,** Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)

**Rantala, K.,** *See* Rantala, E., 12:37071

**Rantama, M.,** *See* Huvinen, T., 12:37087

**Rao, A.R.,** Hydrologic models of surface-mined areas. Technical report, 12:36341 (R;US)

**Rapaport, J.,** (p-arrow-right,n) reaction on carbon isotopes at E/sub p/ = 160 MeV, 12:38241 (J;US)

**Rappaport, B.D.,** Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)

**Rard, J.A.,** Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/ sub 2/ at 25°C, 12:37422 (J;US)
Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C, 12:37423 (J;US)

**Rasera, R.L.,** *See* Jaeger, H., 12:37320

**Rasmussen, J.E.,** Generating plant life upgrade strategy and results, 12:36759 (BA;US)

**Ratcliff, B.N.,** New results on mesons containing strange quarks, 12:38140 (RA;US)

**Rathke, G.E.,** Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)

**Ratzel, A.C.,** CIRCE: Computer code for the analysis of point-focus solar concentrators, 12:36712 (BA;US)

**Rau, H.M.,** Biomass production of problematic sites by generatively and vegetatively propagated high-yield-progenies of fast growing tree species. Final report, 12:36621 (R;DE;In German)

**Raunemaa, T.,** Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
*See* Kulmala, M., 12:37092
*See* Saari, H., 12:37088

**Ravn, H.,** *See* Nielsen, C.S., 12:36385

**Ray, R.J.,** The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)

**Ray, R.M.,** Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)

**Raychaudhuri, K.K.,** *See* Sullivan, M.W., 12:38151

**Raymond, T.D.,** *See* Kay, B.D., 12:38305

**Raynal, D.J.,** *See* LeBlanc, D.C., 12:37805

**Rebbi, C,** *See* Campostrini, M., 12:38155

**Rebello, W.J.,** Cost/performance analysis of high temperature waste heat recovery equipment: Final report, 12:37136 (R;US)

**Reddy, C.S.,** Determination of R-values from in-situ dynamic thermal test data in light weight roof systems, 12:36690 (BA;US)

**Redey, L.,** Power performance of high-temperature Li-alloy/$FeS_2$ bipolar cells in short pulses, 12:36942 (R;US)
*See* Kaun, T.D., 12:36941

**Redi, M.H.,** Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/ sub i/, 12:38344 (R;US)

**Reed, L.D.,** Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)

**Reed, R.M.,** *See* Brown, K.J., 12:36962

**Reed, S.T.,** *See* Ashley, C.S., 12:37369

**Reeh, N.,** Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)

**Reeves, J.H.,** *See* Avignone, F.T. III, 12:38248
*See* Brodzinski, R.L., 12:37569

**Reeves, S.R.,** The influence of reservoir properties and geologic setting on coalbed fracturing and production: A preliminary evaluation of the TEAM project, 12:36444 (BA;US)

**Regenhardt, P.A.,** *See* Bajura, R.A., 12:36257

**Rehbein, D.K.,** Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
*See* Buck, O., 12:37266

**Reich, E.,** *See* Hammermaier, A., 12:37438, 12:37439

**Reif, D.J.,** Canyon solvent cleaning, 12:36485 (R;US)
Canyon solvent cleaning with solid adsorbents, 12:36486 (R;US)

**Reil, J.W.,** *See* Chiappetta, R.F., 12:36346

**Reilly, C.A.,** *See* Gray, R.H., 12:36367

**Reiman, A.,** Method and apparatus for maintaining equilibrium in a helical axis stellarator, 12:38367 (P;US)

**Reinisch, B.W.,** *See* Sales, G.S., 12:38082

**Reisman, D.J.,** Summary review of the health effects associated with copper: health issue assessment, 12:37990 (R;US)

**Reiss, D.B.,** *See* Holman, R., 12:38202

**Reiter, E.R.,** Tibet revisited: TIPMEX-86, 12:37725 (J;US)

**Rej, D.J.,** *See* Siemon, R.E., 12:38341

**Reneau, R.B.,** *See* Rappaport, B.D., 12:37840

**Renieri, A.,** *See* Dattoli, G., 12:37476, 12:37477
*See* Marino, M., 12:37475

**Renken, S.,** *See* Wolff, R.K., 12:37961

**Renne, R.A.,** *See* Gray, R.H., 12:36367

**Rentsch, R.,** *See* Choquard, Ph., 12:38304

**Repond, J.,** Evidence for the decay tau$^-$ $\rightarrow \pi^-$ eta nu/sub tau/, 12:38111 (R;US)

**Retcofsky, H.L.,** *See* Castellano, S.M., 12:36320

**Retherford, R.M.,** Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations, 12:36365 (R;US)

**Rettenberger, G.,** Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report, 12:36580 (R;DE;In German)

**Reuter, W.G.,** Applicability of fracture mechanics to lifetime prediction of B and W ceramic heat exchanger tubes, 12:37137 (R;US)

**Reyes, J.N. Jr.,** *See* Beckner, W.D., 12:36837

**Rhudy, R.G.,** *See* Anderson, J.M., 12:36754

**Ribe, F.L.,** Linear helical-axis stellarator experiments, 12:38336 (RA;FR)

**Ricard, J.,** Continuous production of photovoltaic silicon ribbons by the new pendant drop growth (PDG) method, 12:36629 (R;XE)

**Ricco, A.J.,** *See* Rye, R.R., 12:37520
**Rich, F.,** *See* Doyle, S.M., 12:38083
**Richards, G.N.,** Kinetics of chemisorption and gasification reactions of carbon for evaluation of the role of electron-transfer processes. Annual report, January-December 1986, 12:36460 (R;US)
**Richner, M.,** *See* Analytis, G.Th., 12:36885
**Richter, B.,** The future of electron-positron colliders, 12:37535 (BA;US)
**Ricker, Y.E.,** *See* Layton, D.W., 12:37584
**Ricketts, T.E.,** *See* Bickel, T.C., 12:36471
**Rickman O'Dell, V.,** Inclusive charged and neutral pion photoproduction at 20 GeV, 12:38119 (R;US)
**Ridley, I.,** *See* Beynon, T.G.R., 12:37105
**Riegel, B.,** Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
**Riezebos, H.,** *See* Voigt, M.J.A. de, 12:38258
**Riihiluoma, V.,** *See* Kulmala, M., 12:37092
**Riley, M.O.,** *See* Summers, M.A., 12:37487
**Riley, R.,** *See* Piette, M.A., 12:37073
**Rill, R.L.,** Liquid crystalline phases in concentrated aqueous solutions of $Na^+$ DNA, 12:37868 (J;US)
**Rini, M.J.,** Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987, 12:36361 (R;US)
**Rintamaeki, K.,** Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Risoluti, P.,** The cost of kWh generated from nuclear stations, 12:36798 (R;IT;In Italian)
**Ritchie, D.,** *See* Heinicke, P., 12:38410
**Ritchie, R.H.,** *See* Flores, F., 12:37276
*See* Gras Marti, A., 12:37277
**Ritschard, R.L.,** *See* Greely, K.M., 12:37040
**Ritzman, R.L.,** Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)
**Rivero, J.,** *See* Alonso, A., 12:36878
**Rivero, M.A.,** *See* Chen, B.T., 12:36337
**Rivers, M.L.,** *See* Gordon, B.M., 12:37873
**Rizy, D.T.,** *See* Rockefeller, G.D., 12:36767
**Rizzo, T.G.,** $E^+e^- \rightarrow W^+W^-$ in $E_6$ models with additional neutral gauge bosons, 12:38199 (J;US)
*See* Hewett, J.L., 12:38164
**Robba, A.A.,** *See* Dowdy, E.J., 12:37572
**Roberts, C.J.,** *See* Newsom, P.C., 12:36553
**Roberts, J.B. Jr.,** *See* Phillips, G.C., 12:38121
**Roberts, R.A.,** NDE [nondestructive evaluation] and fracture studies of hot-pressed $Si_3N_4$, 12:37285 (R;US)
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)
*See* Singh, J.P., 12:37292
**Roberts, W.W.,** Collisional dynamics of perturbed particle disks in the solar system. Annual technical progress report, 12:38061 (R;US)
**Robertson, R.G.H.,** *See* Bowles, T.J., 12:38152
*See* Knapp, D.A., 12:38236
**Robinove, C.J.,** *See* Yanosky, T.M., 12:38033
**Robinson, A.,** *See* Sliney, D.H., 12:38011
**Robinson, A.C.,** An analytical model for Rayleigh-Taylor instability in solids, 12:38301 (R;US)
**Robinson, A.L.,** Free-electron laser success explained, 12:37492 (J;US)
**Robinson, B.M.,** *See* Holditch, S.A., 12:36440, 12:36441
**Robinson, C.W.,** Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Robinson, D.A.,** *See* Nelson, B.D., 12:37047
**Roblee, J.W.,** A design procedure to tune the dynamic stiffness of an externally pressurized gas bearing, 12:37469 (R;US)
**Rochelle, J.W.,** *See* Ziegler, N.F., 12:37547
**Rockefeller, G.D.,** Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)
**Rodacy, P.J.,** *See* Burns, F.B., 12:37380
**Rodgers, V.G.J.,** *See* Harari, D., 12:38217
**Rodriguez, J.L.,** *See* Hughes, R.C., 12:37519
**Roeckle, R.,** *See* Klug, W., 12:37598
**Roegiers, J.C.,** *See* Jeffrey, R.G., 12:36398
**Roger, L.J.,** *See* Horstman, D., 12:37994
**Rogers, L.E.,** *See* Van Voris, P., 12:37816
**Rogers, W.E.,** *See* Bilodeau, E.A., 12:36677
**Rohar, P.C.,** *See* Irdi, G.A., 12:36298
**Rohatgi, N.K.,** *See* Collins, E.R., 12:36245
**Roig, F.A.,** Modifications of the Adesmia horrida bushes due to snow weight at the Paramillo de Uspallata, Mendoza, Argentina, 12:37743 (RA;US)
**Rokhlin, S.I.,** Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
**Romanosky, R.R.,** *See* McCarty, D.L., 12:36300
**Romanosky, R.R. Jr.,** Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
**Romanowksi, L.J. Jr.,** Reverse combustion in asphalt ridge tar sand, 12:36468 (R;US)
**Ronan, R.J.,** *See* Seiler, F.A., 12:37620
**Rondinelli, R.,** *See* Lee, S.A., 12:37692
**Roodhart, L.P.,** Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)
**Roots, R.,** *See* Kraft, G., 12:37904
**Roover, B. de,** Mapping and health status assessment of the Flemish forests using remote sensing, 12:37731 (RA;DE)
**Roper, J.R.,** *See* Heiple, C.R., 12:37234
**Roper, P.,** *See* Salisbury, S., 12:37623
**Rose, J.H.,** Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
**Rosenbaum, S.,** *See* Glickstein, R.J., 12:36969
**Rosenfeld, A.,** *See* Akbari, H., 12:37029
**Rosner, J.L.,** Theoretical high energy physics research at the University of Chicago: Technical progress report [for 1986], 12:38160 (R;US)
**Ross, B.A.,** *See* Kannberg, L.D., 12:36904
**Ross, J.S.,** *See* Anderson, R.J., 12:36357
**Ross, M.C.,** *See* Pellegrin, J.L., 12:37555
**Rossi, H.H.,** The multicellular nature of radiation carcinogenesis, 12:37934 (BA;US)
**Rosynek, M.P.,** Properties of lanthanide oxides as supports for transition metal catalysts: Progress report for the period May 1, 1986 to April 30, 1987, 12:37333 (R;US)
*See* Withers, H.P., 12:36582
**Rothenberg, S.J.,** Comparison of indoor dust samples collected in different environments, 12:37618 (RA;US)
*See* Cuddihy, R.G., 12:36832
*See* Eidson, A.F., 12:37404
*See* Finch, G.L., 12:37403
*See* Guilmette, R.A., 12:37907
*See* Hoover, M.D., 12:37616
*See* Wolff, R.K., 12:37967
**Rousseau, D.,** *See* Castro, R., 12:37256
**Routbort, J.L.,** *See* Goretta, K.C., 12:37306
**Roux, J.-J.,** Proposal of a simplified model for building thermal behaviour simulation, 12:37069 (R;FR;In French)
**Rowan, W.L.,** *See* Evans, T.E., 12:38380
**Rowe, R.J.,** Command and control of the US heavy division on the nuclear battlefield, 12:37588 (R;US)
**Rowland, R.E.,** Radium-dial workers, 12:37935 (BA;US)
**Rowley, R.L.,** Thermal conductivities of ternary liquid mixtures, 12:37420 (J;US)
**Roy, N.,** *See* Meyer, R.A., 12:38256
**Roy, R.N.,** *See* Simonson, J.M., 12:36948
**Roybal, J.A.,** *See* Ortiz, S., 12:36564
**Ruck, G.T.,** *See* Thompson, N.G., 12:36458
**Rudaz, O.,** *See* Guisan, O., 12:36703
**Ruderman, H.,** Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Rudman, D.A.,** Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)
**Rudyj, A.,** Investigation of density fluctuations in the edge region of the divertor tokamak ASDEX, 12:38338 (R;DE;In German)
**Ruecker, C.M.,** Design procedure for sizing a submerged-bed scrubber for airborne particulate removal, 12:37722 (R;US)
**Ruggieri, M.R.,** *See* Buddemeier, R.W., 12:37853
**Ruhmann, H.,** *See* Kanzleiter, T., 12:36902
**Rumbaugh, J.H.,** Reliability aspects of wind/diesel hybrid generating systems, 12:36749 (BA;US)
**Rumble, E.,** *See* Theofanous, T.G., 12:36914
**Rundell, D.N.,** Hydrodynamics of four-phase fluidization: Comparison of cold-flow and operating reactor data for a gas/liquid/coal slurry fluidized bed, 12:36280 (J;US)

**Ruokolainen, T.,** *See* Raunemaa, T., 12:37086
**Ruppel, T.C.,** *See* Peters, W.C., 12:37006
**Rush, F.E.,** *See* Dixon, G.L., 12:36509
**Rush, J.,** *See* Sliney, D.H., 12:38011
**Russ, G.P.,** *See* Lindner, M., 12:38257
**Russell, V.I.,** *See* Bond, J.A., 12:37977
**Ryan, B.,** Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)
**Ryan, J.V.,** *See* Mulholland, J.A., 12:37649
*See* Nolen, S.L., 12:37157
**Ryan, M.A.,** Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**Ryan, P.M.,** *See* Owens, T.L., 12:38371
**Rye, R.R.,** Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors, 12:37520 (J;US)
**Rypien, D.V.,** *See* Nagy, P.B., 12:37263, 12:37365

## S

**Saarela, K.,** *See* Jaemsae, S., 12:37091
**Saari, H.,** Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
*See* Kulmala, M., 12:37092
*See* Raunemaa, T., 12:37094
**Saari, M.,** Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)
**Sabbagh, H.A.,** Computation of fields and signals due to ferromagnetic anomalies, 12:37268 (BA;US)
**Sabbagh, L.D.,** *See* Sabbagh, H.A., 12:37268
**Sabharwal, S.C.,** *See* Gadkari, S.C., 12:37510
**Saboungi, M.,** Structure of liquid equiatomic potassium—lead alloy: A neutron diffraction experiment, 12:37246 (J;US)
**Sabourin, P.J.,** Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
*See* Mitchell, C.E., 12:37978
**Sackett, J.G.,** Japan's manufactured housing capability: a review of the industry and assessment of future impact on the US market, 12:37055 (RA;US)
**Sadrozinski, H.F.W.,** *See* Barbiellini, G., 12:38165
**Saell, H.-O.,** *See* Danfors, B., 12:37150
**Sahin, T.,** Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Sakaki, I.,** *See* Iguchi, T., 12:36859
**Salamy, S.P.,** Recovery efficiency aspects of horizontal well drilling in Devonian shale, 12:36434 (BA;US)
*See* Yost, A.B. II, 12:36451
**Salasin, J.,** *See* Linn, C.J., 12:37186
**Sales, B.C.,** Structural nature of the amorphous-to-crystalline transition in phosphate glasses as studied by liquid chromatography, 12:37331 (R;US)
*See* Christen, D.K., 12:37291
**Sales, G.S.,** Preliminary investigation of ionospheric modifucation using oblique-incidence high-power h-f (high-frequency) radio waves. Technical report, 12:38082 (R;US)
**Salisbury, S.,** Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
**Salminen, A.,** *See* Keskinen, J., 12:37089
**Saltin, L.,** Use of oxygen for heating furnaces, 12:37118 (RA;SE)
**Saluja, P.P.S.,** *See* Phutela, R.C., 12:37421
**Samara, G.A.,** Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)
**Samios, N.P.,** High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
*See* Baker, N.J., 12:38243
**Sammells, A.F.,** Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986, 12:36578 (R;US)
**Sampson, W.B.,** *See* Gregory, E., 12:37255
**Sams, T.L.,** *See* McDaniel, E.W., 12:36502
**Sanborn, R.H.,** *See* Leider, H.R., 12:37381
**Sanchez Buelga, A.,** Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Sanders, C.F.,** 1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)
**Sanders, G.A.,** *See* DeBey, T.M., 12:36930
**Sanderson, S.N.,** WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
**Sandervag, O.,** Swedish experience with RELAP5/MOD2 assessment, 12:36874 (RA;US)
**Sandler, S.I.,** *See* Xu, Z., 12:37413
**Sano', A.,** *See* Mazza, M., 12:36980
**Santoleri, J.J.,** Waste fuels: A proven source of energy recovery, 12:36608 (BA;US)
**Santoro, N.,** Characterization of bromoethanesulfonate-resistant mutants of methanococcus voltae: evidence of a coenzyme M transport system, 12:37872 (J;US)
**Saradiji, B.S.,** *See* Salamy, S.P., 12:36434
*See* Yost, A.B. II, 12:36451
**Sarantites, D.G.,** *See* Halbert, M.L., 12:38251
**Sarikov, N.A.,** *See* Kalinovskij, Yu.L., 12:38206, 12:38208
**Sarnes, P.,** *See* Huhtinen, M., 12:36363
**Sarvela, D.P.,** *See* Hippo, E.J., 12:36239
**Satchler, G.R.,** *See* Kobos, A.M., 12:38266
**Sato, K.,** *See* Ebihara, M., 12:37115
**Sattar, M.A.,** Advanced composite combustor structural concepts program. Final Report, 12:37343 (R;US)
**Sattler, M.L.,** *See* Mintz, J.M., 12:38388
**Sauli, J.,** Combined systems sod peat - milled peat, 12:36344 (R;SE;In Swedish)
**Sauthoff, N.R.,** *See* Hill, K.W., 12:38346
**Sauvage, J.P.,** *See* Lehn, J.M., 12:36576
**Savage, W.F.,** *See* Sundell, R.E., 12:37235
**Savastano, C.A.,** Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Sawicka, B.D.,** High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells, 12:37009 (R;US)
**Sawyer, W.K.,** *See* Zuber, M.D., 12:36445
**Schaefer, D.W.,** Fractal aspects of ceramic synthesis, 12:37321 (BA;US)
**Schaefer, P.,** *See* Lay, R., 12:36926
**Schaefer, R.J.,** *See* Rundell, D.N., 12:36280
**Schaeffer, S.,** *See* Romanosky, R.R. Jr., 12:36309
**Schauer, M.M.,** *See* Harrington, M., 12:36953
**Schechter, R.S.,** Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**Scheele, R.D.,** Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)
**Schelling, F.J.,** *See* Murata, K.K., 12:36901
**Scherrer, H.U.,** Large-area inventory of forest damage by means of aerial infrared thermography on a scale of 1:9000, 12:37779 (RA;DE;In German)
**Schettini, G.,** *See* Ciocci, F., 12:37479, 12:37480
**Scheurer, B.,** Remarks on the stability analysis of reactive flows, 12:37442 (R;US)
**Schidlovsky, G.,** *See* Gordon, B.M., 12:37873
**Schiermeier, F.A.,** Sources and evaluation of uncertainty in long-range transport models, 12:37691 (R;US)
*See* Egan, B.A., 12:37663
**Schiffhauer, M.A.,** *See* Scott, D.W., 12:36546
**Schilling, C.H.,** PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)
**Schimetschka, E.,** *See* Langer, G., 12:36822
**Schinder, P.J.,** Neutrino emission by the pair, plasma, and photo processes in the Weinberg-Salam model, 12:38205 (J;US)
**Schindler, R.H.,** Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Schirber, J.E.,** Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Schlaepfer, R.,** Problems in the planning of forest damage inventories, 12:37801 (RA;DE)
**Schlegel, J.A.,** Improving infiltration control techniques in low income weatherization, 12:37056 (RA;US)
**Schlenger, B.J.,** Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions, 12:36824 (R;US)
**Schmid, K.-F.,** *See* Schupe, W., 12:37113
**Schmid-Haas, P.,** Inventorying and monitoring endangered forests, 12:37768 (R;DE;In English, French and German)

Inventorying and monitoring endangered forests. Welcoming remarks, 12:37769 (RA;DE)
**Schmidt, E.,** *See* Khatib-Rahbar, M., 12:36905
**Schmidt, G.L.,** *See* Redi, M.H., 12:38344
**Schneider, C.A.,** Epidermal growth factor-nonresponsive 3T3 variants do not contain epidermal growth factor receptor-related antigens or mRNA, 12:37880 (J;US)
**Schneider, K.,** Physical model for reactor coolant pumps, 12:36871 (RA;US)
**Schneider, W.F.W.,** *See* Sohlbach, H., 12:38260
**Schnell, R.,** Influence of radiation treatment on pharmaceuticals and auxiliary ingredients. A review. Pt. 7, 12:37440 (R;DE;In German)
**Schobert, H.H.,** New approaches to the characterization of lignites: a combined geological and chemical study, 12:36323 (BA;NL)
**Schoeck, W.,** *See* Kanzleiter, T., 12:36902
**Schoen, E.,** *See* Brown, H.D., 12:38404
**Schoepfer, W.,** Flexible system to monitor the health status of a forest, 12:37791 (RA;DE;In German)
**Scholz, W.,** *See* Homan, C.G., 12:37528
**Schramm, D.N.,** Weak interaction and the large scale structure of the universe, 12:38079 (BA;DE)
*See* Schinder, P.J., 12:38205
**Schraufnagel, R.A.,** *See* Zuber, M.D., 12:36445
**Schriever, K.,** Study investigating the impact of aircraft noise on physiological, endocrinological and ethological criteria with regard to pregnant sows, roaming free or kept in barns, 12:38014 (R;DE;In German)
**Schroeder, J.E.,** *See* Suitor, J.W., 12:36254, 12:36256
**Schroeder, V.,** *See* Behrend, H.J., 12:38116
**Schroeder-Obst, D.,** Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
**Schroeter, H.,** Investigations performed on permanent observation plots established by the Forest Research Institute (FVA) of the State of Baden-Wuerttemberg, 12:37792 (RA;DE;In German)
**Schubert, W.K.,** *See* Hughes, R.C., 12:37519
**Schuell, D.,** *See* Sohlbach, H., 12:38260
**Schuettler, C.,** Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 1, 12:37898 (R;DE;In German)
Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 2, 12:37899 (R;DE;In German)
**Schug, A.,** Methane production from lactose via defined mixed cultures of bacteria, 12:36631 (R;DE;In German)
**Schuk, W.W.,** *See* James, S.C., 12:37815
**Schultz, R.,** *See* Motley, F., 12:36849
**Schulz, H.,** Theoretical and experimental investigations of ignition, combustion and expansion processes of hypergolic liquid fuel combinations at gas temperatures up to 3000 deg K. Thesis - Rhein-Westfalia Technical Coll., 1967, 12:37441 (R;US)
**Schulz, R.P.,** *See* Chari, M.V.K., 12:36753
**Schulze, G.K.,** *See* Ziegler, N.F., 12:37547
**Schunk, R.W.,** Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986, 12:38086 (R;US)
**Schupe, W.,** Process control of continuous heating furnaces - strategy of a calculation model and operating results, 12:37113 (RA;SE)
**Schuresko, D.D.,** Pellet injector research at ORNL, 12:38372 (R;US)
**Schwalm, R.W.,** Vehicle tracking systems, 12:38396 (R;US)
**Schwartz, G.,** *See* Conti, M., 12:37573
**Schwartz, M.M.,** *See* Pacheco, M.A., 12:36290
**Schwartz, R.W.,** Precipitation of PZT and PLZT powders using a continuous reactor, 12:37314 (BA;US)
**Schwarz, A.S.,** Higgs boson production at the $Z^0$ and the possibilities of vertex detectors, 12:38183 (RA;US)
**Schwarz, J.A.,** *See* Huang, Y.J.R., 12:36594
**Schwarzmeier, J.L.,** Symmetry properties of a multidimensional dispersion functional, 12:38363 (J;US)
**Schweingruber, F.H.,** Abrupt changes in growth reflected in tree ring sequences as an expression of biotic and abiotic influences, 12:37798 (RA;DE)
Potentials and limitations of dendrochronology in pollution research, 12:37806 (RA;US)
**Schwitters, R.,** *See* Huson, R., 12:37574
**Schwob, J.L.,** High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics, 12:38347 (R;US)
**Schwoebel, J.J.,** *See* Logan, T.L., 12:36452
**Schwope, A.D.,** Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
**Schygulla, U.,** *See* Wolf, L., 12:36888
**Scott, A.G.,** *See* Henschel, D.B., 12:37720
**Scott, B.D.,** *See* Pellegrin, J.L., 12:37555
**Scott, B.R.,** *See* Hahn, F.F., 12:37908
**Scott, D.W.,** The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
**Scott, J.D.,** *See* Rappaport, B.D., 12:37840
**Scott, P.A.,** *See* Ruecker, C.M., 12:37722
**Scott, R.A.,** *See* Shelnutt, J.A., 12:36593
**Scott, R.G.,** *See* Hayatsu, R., 12:36294
**Scott, S.H.,** Vault demonstration program, 12:37596 (R;US)
**Scudder, D.W.,** *See* Hammel, J.E., 12:38340
**Scully, M.O.,** Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
**Sczurko, J.J.,** Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**Sealock, L.J. Jr.,** *See* Elliott, D.C., 12:36591
**Sebesta, Z.,** Alternative energy supply systems for lettuce production in greenhouses, 12:37145 (R;NO;In Norwegian)
**Secco, A.,** *See* Voet, D., 12:37861
**Sedman, C.B.,** *See* Ando, J., 12:36334
*See* Jozewicz, W., 12:36331, 12:37669
**Sedwick, K.,** *See* Mc Fall, K.S., 12:36447
**Seeman, S.E.,** *See* Smith, D.E., 12:36815
**Segal, H.M.,** Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)
**Segner, H.,** Effects of environmental factors (food, heavy metals) on teleostean hepatocytes, 12:37986 (R;DE;In German)
**Seigneur, C.,** Simulation of aerosol dynamics: a comparative review of mathematical models, 12:37643 (R;US)
**Seiler, F.A.,** Performance of continuous air monitors based on alpha spectroscopy in a dusty environment, 12:37714 (RA;US)
Source strength of thick, continuously deposited alpha sources, 12:37715 (RA;US)
Use of risk assessment methods in the certification of decontamination buildings, 12:37620 (RA;US)
*See* Brooks, A.L., 12:37928
*See* Newton, G.J., 12:37716
**Seinfeld, J.H.,** *See* Seigneur, C., 12:37643
**Sekula, S.T.,** *See* Christen, D.K., 12:37291
*See* Thompson, J.R., 12:37212, 12:37294
**Selcow, E.C.,** One and two dimensional radiation analysis of the compact ignition tokamak, 12:38369 (R;US)
**Seldowitz, M.A.,** Synthesis of digital holograms by direct binary search, 12:38313 (J;US)
**Selkowitz, S.E.,** A concept for an advanced computer-based building envelope design tool, 12:37072 (R;US)
**Semkow, T.M.,** *See* Halbert, M.L., 12:38251
**Sen, Ayusman,** Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**Sena, J.T.,** *See* Merrigan, M.A., 12:36803
**Senftle, F.E.,** *See* Thorpe, A.N., 12:36312, 12:36313, 12:36314
**Sengers, J.V.,** *See* Nieuwoudt, J.C., 12:37416
**Sengupta, M.,** *See* Ramachandran, N., 12:37108
**Sepaniak, M.J.,** *See* Kettler, C.N., 12:37385
**Sepehrnoori, K.,** *See* Pope, G.A., 12:36379
**Seppaenen, O.,** Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
**Serot, D.E.,** The value of conservation in the Pacific Northwest, 12:37014 (R;US)
**Serre-Bachet, F.,** Tree-growth, ARMA modelling and pollution, 12:37955 (RA;US)
**Sesnic, S.,** *See* Hill, K.W., 12:38346
**Seth, S.,** *See* Lay, R., 12:36926

**SethuRaman, S.,** Analysis and evaluation of statistical coastal fumigation models, 12:37640 (R;US)
**Seto, M.,** *See* Fisher, R.A., 12:37226
**Severud, L.K.,** Elastic creep-fatigue evaluation for ASME [American Society of Mechanical Engineers] code, 12:37505 (R;US)
**Sexton, J.H.,** Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**Seyboth, J.,** *See* Aderholz, M., 12:37565
**Seyerlein, J.,** *See* Aderholz, M., 12:37565
**Seyler, C.E.,** *See* Schwarzmeier, J.L., 12:38363
**Shabana, E.,** *See* Theofanous, T.G., 12:36857
**Shafer, R.,** *See* Diebold, R., 12:37536
**Shafer, S.R.,** *See* Bruck, R.I., 12:37999
**Shaffer, P.T.B.,** Production of fine, high-purity, beta SiC powder, 12:37282 (R;US)
**Shah, Y.,** Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)
Coal liquefaction with liquid clathrates, 12:36264 (RA;US)
Modeling of Wilsonville Integrated Two-stage Liquefaction (ITSL) process, 12:36261 (RA;US)
Strong acids as catalysts for the direct liquefaction of coal, 12:36263 (RA;US)
**Shalek, P.D.,** *See* Gac, F.D., 12:37300
**Shao, J.D.,** State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+$ ($^2$P/sub 3/2/) + Ar($^1S_0$) and $Ar^+$ ($^2$P/sub 3/2/) + $N_2$(X,v = 0), 12:38097 (D;US)
**Shapiro, W.,** High-temperature rotating shaft seal, 12:36253 (RA;US)
**Sharpe, S.R.,** How to measure $\epsilon'/\epsilon$ with lattice QCD, 12:38224 (R;US)
**Shaug, J.C.,** *See* Andersen, J.G.M., 12:36876
*See* Tsunoyama, S., 12:36877
**Shea, M.A.,** *See* Flueckiger, E.O., 12:38084
**Sheaffer, J.D.,** *See* Reiter, E.R., 12:37725
**Sheehy, J.W.,** In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
*See* Lenihan, K.L., 12:37677
**Sheen, S.H.,** Advanced research in instrumentation and control technology: acoustic parameter studies, 12:36306 (RA;US)
**Sheffield, J.,** Ignition physics study group support of the engineering test reactor program, 12:38375 (R;US)
The ignition physics study group supports the compact ignition tokamak and engineering test reactor programs, 12:38376 (R;US)
**Sheih, A.S.L.,** *See* Allison, C.M., 12:36908
**Sheldon, M.S.,** *See* Cetegen, B.M., 12:36765
**Shelnutt, J.A.,** Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)
*See* Stohl, F.V., 12:36600
**Shen, L.,** State of Minnesota high level weatherization project, 12:37057 (RA;US)
**Shepherd, P.B.,** Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing, 12:37139 (R;US)
**Sheppard, P.R.,** Dating earthquakes along the San Andreas fault system in California, 12:37752 (RA;US)
Fire history of lodgepole pine of Mt. San Jacinto, California, 12:37746 (RA;US)
**Sherman, M.P.,** *See* Berman, M., 12:36915
**Sheron, B.W.,** Experience with the revised Appendix K, 12:36839 (RA;US)
**Shiang, D.,** *See* Sweet, D.V., 12:38005
**Shiau, S.M.,** The effect of radiation on twinning in quartz, 12:37361 (J;US)
**Shieh, S.,** *See* Almenas, K., 12:36846
**Shiemke, A.K.,** *See* Shelnutt, J.A., 12:36593
**Shillenn, J.K.,** *See* Witzig, W.F., 12:36554
**Shinn, M.D.,** Promethium ($Pm^{3+}$) solid state laser, 12:37474 (R;US)
**Shipley, J.P.,** The R and D/operational MC and A [materials control and accounting] interface, 12:36560 (R;US)
**Shipman, J.D. Jr.,** Minimum inductance laser head for pulsed transverse discharges without wall tracking, 12:37490 (P;US)
**Shiralkar, B.S.,** *See* Andersen, J.G.M., 12:36876
*See* Tsunoyama, S., 12:36877
**Shirane, G.,** Magnetism of MnSi and FeSi, 12:37328 (R;US)
Temperature-induced magnetism in FeSi, 12:37249 (J;US)
**Shire, P.,** *See* Boyack, B.E., 12:36863
**Shirey, D.L.,** *See* Gorham-Bergeron, E., 12:36466
**Shirts, M.B.,** *See* Dean, K.C., 12:37672
**Shiver, B.D.,** *See* Brister, G.H., 12:37786
**Shockey, D.A.,** *See* Giovanola, J.H., 12:37199
**Shoemaker, P.E.,** *See* Magnani, N.J., 12:36944
**Short, W.,** *See* Anderson, J., 12:36670
**Shou, J.K.,** *See* Rundell, D.N., 12:36280
**Shriner, C.R.,** Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)
**Shroder, J.F. Jr.,** Tree-ring analysis in the earth sciences, 12:37751 (RA;US)
**Shum, D.P.C.,** Electron-tunneling studies of Mo/sub 1-x/Re/sub x/: enhancement of superconductivity by a resonance mode, 12:37275 (D;US)
**Shunk, E.R.,** *See* Dowdy, E.J., 12:37572
**Siccama, T.G.,** *See* Kim, E., 12:37736
**Sick, F.,** Analysis of the seasonal performance of hybrid desiccant cooling systems, 12:36681 (R;US)
**Siebe, D.A.,** *See* Boyack, B.E., 12:36845
**Siefken, L.J.,** *See* Allison, C.M., 12:36908
**Siemon, R.E.,** Field-reversed configuration formation and confinement studies on the LSM device, 12:38341 (R;US)
**Sigmar, D.J.,** *See* Spong, D.A., 12:38323
**Sijacki, D.,** *See* Ne'eman, Y., 12:38227
**Sikivie, P.,** *See* Harari, D., 12:38057
**Sikka, V.K.,** Electroslag component casting, 12:36250 (RA;US)
**Silk, J.,** Gamma-ray constraint on the nature of dark matter, 12:38077 (J;US)
**Silver, D.,** *See* Watson, R.H., 12:37059
**Silver, H.F.,** Use of basic nitrogen to chemically clean coal: Quarterly report No. 3 for the period March 16, 1987 to June 15, 1987, 12:36238 (R;US)
**Silver, H.J.,** *See* Hurtubise, R.J., 12:36310
**Simmons, G.J.,** A natural taxonomy for digital information authentication schemes, 12:38399 (R;US)
Authentication codes that permit arbitration, 12:38398 (R;US)
Reliable communications in a network with unreliable key distribution centers, 12:36565 (R;US)
**Simmons, W.F.,** *See* Marietta, M.G., 12:36536
**Simonen, E.P.,** *See* Levy, I.S., 12:36494
**Simonen, F.A.,** *See* Alzheimer, J.M., 12:36778
**Simons, D.S.,** *See* Lindner, M., 12:38257
**Simons, R.L.,** Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)
**Simonson, J.M.,** Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**Simpson, T.W.,** *See* Rappaport, B.D., 12:37840
**Sims, R.J.,** *See* Puckett, D.A., 12:36369
**Singh, J.,** *See* Mazumder, J., 12:37201
**Singh, J.J.,** Simplified method for determining heat of combustion of natural gas, 12:36462 (R;US)
**Singh, J.P.,** Effect of flaws on the fracture behavior of structural ceramics, 12:37292 (R;US)
*See* Roberts, R.A., 12:37285
**Singh, K.D.,** Review of recent FAO contributions to inventorying and monitoring of tropical forests (1979-1985), 12:37896 (RA;DE)
**Singh, M.,** *See* Millar, M., 12:36416
**Sinha, L.S.,** *See* Collins, N.E., 12:37017
**Siren, K.,** *See* Rintamaeki, K., 12:37082
**Sirkiae, T.,** Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)
**Sistemich, K.,** *See* Meyer, R.A., 12:38256
**Sivukari, M.,** *See* Lindholm, M., 12:37083
**Sjoestroem, K.,** Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Skinner, L.,** *See* Lay, R., 12:36926
**Slade, R.,** *See* Hatch, G.E., 12:37993
*See* Massaro, E.J., 12:38004
**Sliney, D.H.,** Laser Hazards Bibliography (12th Edition), 12:38011 (R;US)
**Slovik, G.,** Particle Bed Reactor scaling relationships, 12:36784 (R;US)
**Smallwood, D.,** *See* Paez, T.L., 12:37508
**Smart, D.F.,** *See* Flueckiger, E.O., 12:38084
**Smart, J.A.,** The Livermore Security Console system, 12:36572 (R;US)
**Smeers, Y.,** Economic analysis of natural gas contracts, 12:36435 (R;NO)
**Smith, A.O.,** *See* Bruggink, D.J., 12:37856
**Smith, D.E.,** CLEO: A knowledge-based refueling assistant at FFTF, 12:36815 (R;US)
**Smith, D.L.,** Development of the Be(d,n) neutron source for cross-section

investigations in the few-MeV energy range, 12:38233 (R;US)
*See* Woodruff, D.M., 12:38303
**Smith, E.A.,** *See* Reiter, E.R., 12:37725
**Smith, E.H.,** *See* Mott, R.E., 12:36370
**Smith, J.,** *See* Wagner, S., 12:38172
**Smith, J.F.,** *See* Clark, A.V. Jr., 12:37264
*See* Thompson, R.B., 12:37265
**Smith, J.L.,** *See* Arko, A.J., 12:37204
*See* Fisher, R.A., 12:37228
**Smith, K.L.,** *See* Lang, K.R., 12:38054, 12:38056
**Smith, L.,** Luminosity of continuous beams with crossing angle, 12:37546 (BA;US)
**Smith, M.J.,** Waste disposal package, 12:36542 (P;GB)
**Smith, M.R.,** *See* Laul, J.C., 12:38045
**Smith, N.S.,** *See* Fasching, G.R., 12:36356
**Smith, O.L.,** Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
**Smith, R.A.,** *See* Krommes, J.A., 12:38349
**Smith, R.B.,** *See* Hornbeck, J.W., 12:37737
**Smith, R.D.,** Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high molecular weight coal components, 12:36301 (RA;US)
**Smith, R.E.,** NASA/MSFC prediction techniques, 12:38060 (RA;US)
**Smith, R.M.,** *See* Breen, S.P., 12:37013
**Smith, R.P.,** *See* McCardell, R.K., 12:36895
**Smith, S.A.,** National Air Toxics Information Clearinghouse (NATICH) data base user's guide for data entry and editing. Interim report, 12:37641 (R;US)
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)
**Smithe, D.N.,** An algorithm for the calculation of 3-D ICRF [Ion Cyclotron Range of Frequencies] fields in tokamak geometry, 12:38345 (R;US)
**Smykala, J.,** Inventorying and monitoring endangered forests in the People's Republic of Poland, 12:37793 (RA;DE;In German)
**Smyth, V.,** Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report, 12:36735 (R;NZ)
**Sniff, B.,** Code name: Opportunity battery: Phases 1 and 2 of Department of Energy Business Plan, 12:38392 (R;US)
**Snipes, M.B.,** Comparative simulated lung burdens of dust in rats, guinea pigs, and dogs with chronic inhalation exposures, 12:37963 (RA;US)
Model for deposition and long-term disposition of $^{134}$Cs-labeled fused aluminosilicate particles inhaled by guinea pigs, 12:37962 (RA;US)
Toxicity of $^{90}$Sr inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
*See* Hahn, F.F., 12:37908
**Snodgrass, L.J.,** *See* Figley, D.A., 12:37038
**Snover, K.A.,** *See* Kicinska-Habior, M., 12:38244
**Sobajima, M.,** *See* Iwamura, T., 12:36860
**Soderstrom, E.,** *See* Banks, T., 12:38181
**Sohlbach, H.,** Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
**Sokolow, R.,** *See* Elliott, L.J., 12:37631
**Solberg, D.E.,** Status of integral facilities and future plans for integral testing, 12:36840 (RA;US)
**Solbrig, C.W.,** Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
**Soldat, J.K.,** *See* Strenge, D.L., 12:37931
**Solomon, J.M.,** *See* Szymczak, W.G., 12:38104
**Solomon, O.M. Jr.,** *See* Bateman, V.I., 12:37579
**Solymos, R.,** Special inventories to record the state of health of forest in Hungary and its improvement, 12:37940 (RA;DE;In German)
**Somoano, R.,** *See* Yen, S.P.S., 12:37368
**Son, J.Y.,** *See* Giel, T.V. Jr., 12:36307
**Sonnier, C.S.,** *See* Darnell, R.A., 12:36568
*See* Mangan, D.L., 12:36571
**Sorensen, N.R.,** Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
**Soresina, R.,** Plant solutions to reduce energy consumption in reheating furnaces, 12:37127 (RA;SE)
**Spall, W.D.,** *See* Parkinson, W.J., 12:36472
**Spann, J.F.,** *See* Maloney, D.J., 12:36359
**Spanne, P.,** *See* Gordon, B.M., 12:37873
**Spanner, G.E.,** Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Spanos, E.K.,** *See* Watt, R.G., 12:38386
**Sparks, L.,** Resistive-heating instability of a compressible, force-free plasma, 12:38362 (J;US)
**Sparks, L.E.,** Comparison of electrostatic-precipitator performance with pulse and d-c energization, 12:37668 (R;US)
*See* Lawless, P.A., 12:37652
**Spehar, R.L.,** Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)
**Speight, J.G.,** Oxidation and coal structure, 12:36322 (BA;NL)
**Spergel, D.N.,** *See* Avignone, F.T. III, 12:38248
**Spicer, C.W.,** Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)
**Spiller, L.L.,** *See* Durham, J.L., 12:37646
**Spingarn, J.R.,** *See* Thomas, G.H., 12:37272
**Spiro, C.L.,** *See* Maylotte, D.H., 12:36299
**Spong, D.A.,** Modification of tokamak ballooning stability boundaries by alpha populations, 12:38323 (R;US)
**Spooner, S.,** *See* Hardman-Rhyne, K.A., 12:37312
**Spore, J.W.,** TRAC code development status and plans, 12:36867 (RA;US)
*See* Booker, C.P., 12:36870
**Sprague, R.E.,** *See* Lindsay, C.N., 12:36563
**Sprecher, R.F.,** *See* Castellano, S.M., 12:36320
**Spriggs, D.F.,** Development of free-steered vehicles, 12:36339 (R;GB)
**Springer, E.P.,** Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)
**Squattrito, P.J.,** Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Squires, M.P.,** Development of an innovative, low-cost solar collector: Final technical report, 12:36685 (R;US)
**Srivastava, P.C.,** *See* Knapp, F.F. Jr., 12:37878
**Srivastava, R.K.,** Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)
**St. John, C.M.,** Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel, 12:36534 (R;US)
*See* Arulmoli, K., 12:36538
**Stacey, G.,** *See* Cangelosi, G.A., 12:37865
**Staed, T.P.,** *See* Carli, G., 12:36664
**Staedtke, H.,** *See* Kolar, W., 12:36884
**Staenz, K.,** *See* Meyer, P., 12:37778
**Staffansson, H.,** Hydrogeological studies of peatlands at Haerjedalen, 12:36345 (R;SE;In Swedish)
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
**Stahle, D.W.,** Environmental factors involved in the growth and distribution of post oak in the southcentral United States, 12:37739 (RA;US)
**Stair, C.L.,** *See* Mitchell, M.E., 12:36960
**Stallmann, F.W.,** Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
**Stamoudis, V.C.,** *See* Zaromb, S., 12:37957
**Stanford, R.M.,** *See* Burton, T.M., 12:37843
**Stanley, J.T.,** *See* Cost, J.R., 12:37222
**Starkman, G.D.,** *See* Avignone, F.T. III, 12:38248
**Stavert, D.M.,** Work performance evaluation using the exercising rat model, 12:37959 (R;US)
**Stead, A.G.,** *See* Hatch, G.E., 12:37993
**Steel, D.G.,** *See* Lam, J.F., 12:38091
**Stefanov, B.,** Kinetics of excitation and ionization of Be I in tokamak devices, 12:38354 (R;DE)
**Stefanson, V.W.,** *See* Nevitt, R.M., 12:37051
**Stegelmeir, B.,** *See* Harmsen, A.G., 12:37964
**Stein-Schabes, J.A.,** Cosmic strings in an expanding spacetime, 12:38058 (R;US)
**Steiner, D.,** Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**Steiner, H.,** Measurement of electron beam polarization at the SLC, 12:37564 (R;US)
**Steiner, J.L.,** *See* Boyack, B.E., 12:36845
**Steinke, R.G.,** *See* Spore, J.W., 12:36867
**Steinlin, H.,** What does a forest politician expect from forest inventory, 12:37893 (RA;DE;In German)
**Stella, L.,** *See* Haberl, F., 12:38073

**Stellmaschek, K.H.,** *See* Dix, W.R., 12:37875
**Stempel, K.E.,** *See* Kandpal, R.P., 12:37866
**Stencel, J.M.,** *See* Pennline, H.W., 12:37412
**Stensland, G.,** Optimal investments using empirical dynamic programming with application to natural resources, 12:36436 (R;NO)
**Stephens, F.S.,** *See* Voigt, M.J.A. de, 12:38258
**Stephens, J.R.,** Superalloy resources: Supply and availability, 12:37230 (R;US)
**Stephens, P.W.,** *See* Mihaly, L., 12:37355
**Stephenson, E.E.,** *See* Mulholland, J.A., 12:37649
**Stephenson, G.J.,** *See* Haxton, W.C., 12:38290
**Stephenson, R.,** *See* Zey, J.N., 12:37890
**Stephenson, R.L.,** Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
**Stepp, J.C.,** Seismic hazard methodology for nuclear facilities: modeling input interpretations, 12:36892 (RA;US)
**Stern, J.P.,** Soviet energy exports to world markets, 12:36990 (RA;SE)
**Stern, M.,** Coupling boundary integral and finite element formulations for nonlinear halfspace problems, 12:38412 (R;US)
**Stetter, J.R.,** Sensor array for toxic gas detection, 12:37707 (P;US)
**Stevens, C.R.,** *See* Chu, B.B., 12:36891
**Stevens, J.E.,** *See* Hill, K.W., 12:38346
**Stewart, A.J.,** *See* Boston, H.L., 12:37838
**Stewart, G.R.,** *See* Roberts, W.W., 12:38061
**Sticker, H.,** *See* Fackler, O., 12:38198
**Stiegel, G.J.,** *See* Narain, N.K., 12:36282
*See* Tischer, R.E., 12:36279
**Stillwagon, T.,** Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)
**Stillwagon, T.L.,** High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report, 12:37138 (R;US)
**Stinton, D.P.,** *See* Lowden, R.A., 12:37301
**Stockburger, L.,** *See* Durham, J.L., 12:37639, 12:37646
**Stockhausen, W.,** An upper limit on the decay $D^0 \rightarrow \mu e$, 12:38148 (R;US)
The decay tau $\rightarrow$ rho nu (and rho $\rightarrow \pi$ eta nu?), 12:38149 (R;US)
**Stocks, G.M.,** *See* Turchi, P.E.A., 12:37245
**Stohl, F.V.,** The testing of catalysts for alkane activation, 12:36600 (R;US)
**Stokowski, S.E.,** *See* Summers, M.A., 12:37487
**Stokstad, R.G.,** *See* Chan, Y., 12:38261
**Stone, C.M.,** *See* Costin, L.S., 12:38047
**Stone, G.,** *See* Reiter, E.R., 12:37725
**Stone, K.R.,** *See* Bajura, R.A., 12:36257
**Stormont, J.C.,** Small-Scale Seal Performance Test Series "A" thermal/structural data through the 180th day, 12:37347 (R;US)
Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986, 12:36540 (R;US)
**Stradley, J.G.,** *See* Groenier, W.S., 12:36488
**Strain, B.R.,** Potential physiological and ecological effects of increasing $CO_2$ on forests, 12:37948 (RA;US)
*See* Telewski, F.W., 12:37951
**Strain, R.V.,** *See* Akers, D.W., 12:36894
**Strand, M.,** *See* Dalton, J.P., 12:37900
**Strandberg, G.W.,** The solubilization of low-ranked coals by microorganisms, 12:36295 (R;US)
**Strauss, J.L.,** Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis, 12:38307 (R;US)
**Streit, J.E.,** Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
**Strenge, D.L.,** GASPAR II: Technical reference and user guide, 12:37931 (R;US)
**Strickland, J.H.,** VAWT stochastic wind simulator, 12:36742 (R;US)
**Stridsberg, S.,** Chipping, transport and firing of energy forest wood. Practical tests during the winter of 1985/1986, 12:36639 (R;SE;In Swedish)
**Strinati, G.,** *See* Castellani, C., 12:38219
**Strines, A.B.,** Computer fallout code using variable winds for operational-type studies. Master's thesis, 12:37586 (R;US)
**Strinivasan, M.G.,** *See* Doss, E.D., 12:36244
**Strip, D.R.,** Insertions using geometric analysis and hybrid force-position control on a PUMA 560 with VAL II, 12:37463 (R;US)
Robotic handling of spent fuel shipping casks: Preliminary assessment of cask design impacts and technology development needs, 12:37461 (R;US)
**Strong, K.T.,** *See* Lang, K.R., 12:38054, 12:38056
**Stroynowski, R.,** *See* Banks, T., 12:38181
**Strugalski, Z.,** *See* Grishin, V.G., 12:38255
**Stuart, J.,** *See* Weitz, R., 12:37591, 12:37592
**Studley, R.V.,** A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)
**Stull, J.O.,** *See* Schwope, A.D., 12:37449, 12:37451
**Stumpf, H.,** *See* Boyack, B.E., 12:36863
**Stupin, D.M.,** Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**Stutzke, M.A.,** *See* Davidson, E.H., 12:36850
**Su, Y.F.,** Diffusivity study of free thoron decay products by deposition measurement on cylindrical tubes and screens, 12:37713 (RA;US)
**Suckewer, S.,** *See* Schwob, J.L., 12:38347
**Sud, K.K.,** *See* Wright, L.E., 12:38275
**Sudarshan, E.C.G.,** Light and group theory, 12:38228 (BA;US)
**Sugimoto, J.,** *See* Iguchi, T., 12:36858
**Sugisaka, M.,** *See* Helferty, J.J., 12:36717
**Sugiyama, S.,** *See* Abe, M., 12:37107
**Suidan, M.T.,** Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)
**Suitor, J.W.,** Zirconia cell oxygen source, 12:36254 (RA;US)
Zirconia tape casting, 12:36256 (RA;US)
**Sujkowski, Z.,** *See* Voigt, M.J.A. de, 12:38258
**Sukiennick, B.A.,** *See* Bulos, F., 12:37554
**Sullivan, M.W.,** Measurement of the ratio of $\Sigma^0$ to $\Lambda^0$ inclusive production from 28.5-GeV/c protons on beryllium, 12:38151 (J;US)
**Sullivan, R.,** *See* Lay, R., 12:36926
**Sullivan, R.B.,** Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
**Sullivan, T.,** Evaluation of local strain fields at [001] twist boundaries in silicon with transmission electron microscope diffraction: Final subcontract report, 12:36635 (R;US)
Low-level waste source term evaluation: Review of published modeling and experimental work, and presentation of low-level waste source term modeling framework and preliminary model development: Topical report, 12:36521 (R;US)
**Summers, M.A.,** High average power solid state laser developments at the Lawrence Livermore National Laboratory, 12:37487 (R;US)
**Sun, J.D.,** Factors affecting lung retention of $^{14}$C-benzo(a)pyrene adsorbed on carbon black particles, 12:37968 (RA;US)
Possible role of reduced glutathione in the development of pulmonary fibrosis, 12:37974 (RA;US)
*See* Kirkpatrick, D.T., 12:37975
*See* Wolff, R.K., 12:37967
**Sundelin, R.M.,** *See* Grunder, H.A., 12:37532
**Sundell, R.E.,** Minor element effects on gas tungsten-arc weld penetration, 12:37235 (RA;US)
**Sung, W.,** Performance comparison of vertical and horizontal hydraulic fractures and horizontal boreholes in low permeability reservoirs: A numerical study, 12:36453 (BA;US)
**Sunier, J.W.,** *See* Cizewski, J.A., 12:38262
**Suresh, D.,** Thermal design of new 'trumpet' secondary concentrators using computer modelling, 12:36710 (BA;US)
**Suter, G.W.,** External heavy-atom effect in room-temperature phosphorescence, 12:37382 (J;US)
**Sutherland, E.K.,** Factors affecting the growth response of ponderosa pine to prescribed burning, 12:37756 (RA;US)
*See* Treshow, M., 12:37945
**Sutherland, W.H.,** *See* Lovell, A.J., 12:36783
**Sutter, F.C.,** Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout, 12:37836 (R;US)
**Sutton, S.R.,** *See* Gordon, B.M., 12:37873
**Suzuki, T.,** Exemplary assessment of forest monitoring from air pollution. Analysis of diameter increase

variations, 12:37799 (RA;DE;In German)
**Suzuki, Y.,** $\nu$/sub $\mu$/e $\rightarrow$ $\nu$/sub $\mu$/e and $\nu$/sub $\mu$/p $\rightarrow$ $\nu$/sub $\mu$/p, 12:38114 (R;US)
**Svec, W.A.,** *See* Wasielewski, M.R., 12:36622, 12:36623
**Svendsen, T.B.,** Application of computerised systems to the nation-wide forest inventory in Denmark with emphasis on the possibilities of conducting inventory and monitoring of endangered forests, 12:37803 (RA;DE)
**Sveum, P.,** *See* Denstad, J.P., 12:36423
**Swain, A.D.,** Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
**Swain, D.W.,** Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)
*See* Hoffman, D.J., 12:38373
**Swaminathan, P.,** *See* Voet, D., 12:37861
**Swanson, W.P.,** *See* McCaslin, J.B., 12:37558
**Sweeney, D.W.,** *See* Seldowitz, M.A., 12:38313
**Sweet, D.V.,** Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the rtecs computer tape. Annual edition, 12:37992 (R;US)
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)
**Swenberg, C.E.,** *See* Yoshida, H., 12:38010
**Swetnam, T.W.,** Western spruce budworm outbreaks in northern New Mexico: tree-ring evidence of occurrence and radial growth impacts from 1700 to 1983, 12:37883 (RA;US)
**Swift, D.L.,** *See* Cheng, Y.S., 12:37960
**Swindeman, R.W.,** Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
*See* Carolan, R.A., 12:37231
**Swinnerton, D.,** Some preliminary results of post-dryout heat transfer measurements at low qualities and pressures up to 20 bar, 12:36883 (RA;US)
**Switendick, A.C.,** Electronic structure of boron and boron rich borides, 12:37239 (R;US)
**Swor, C.T.,** *See* Bruggink, D.J., 12:37856
**Szalewicz, K.,** *See* Fackler, O., 12:38198
**Szymczak, W.G.,** Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)

## T

**Tabasaran, O.,** *See* Rettenberger, G., 12:36580
**Taddeucci, T.N.,** *See* Rapaport, J., 12:38241
**Tagart, S.W.,** *See* Tang, H.T., 12:36890
**Taha, H.,** *See* Akbari, H., 12:37029
**Tait, A.M.,** *See* Pacheco, M.A., 12:36290
**Tajima, K.,** *See* Shirane, G., 12:37249
**Tajima, T.,** *See* Berk, H.L., 12:38331
**Takahashi, H.,** Some thoughts on the muon catalyzed fusion reactor, 12:38320 (R;US)
**Takasaki, M.,** *See* Green, D., 12:37571
**Takeshima, R.,** *See* Ebihara, M., 12:37115
**Tallant, D.R.,** *See* Balfe, C.A., 12:37427
**Tallent, O.K.,** *See* McDaniel, E.W., 12:36502
**Talvacchio, J.,** *See* Rudman, D.A., 12:37283
**Tamura, K.,** Excess molar enthalpies for the 1-butanol-benzene-cyclohexane system at 25°C, 12:37419 (J;US)
**Tan, Chung-I,** *See* Feldman, D., 12:38158
**Tanaka, M.,** *See* Baker, N.J., 12:38243
**Tang, H.T.,** Containment and piping research, 12:36890 (RA;US)
**Tang, W.M.,** *See* Lee, W.W., 12:38353
*See* Redi, M.H., 12:38344
**Tanveer, S.,** Analytic theory for the linear stability of the Saffman—Taylor finger, 12:38105 (J;US)
**Tarapore, P.S.,** Verification report for SIMREP 1.1, 12:36499 (R;US)
**Tarbell, W.W.,** DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
**Tarrer, A.R.,** *See* Guin, J.A., 12:36317
**Tasaka, K.,** Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)
**Tasseff, T.W.,** Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)
**Tatarchuk, B.J.,** *See* Cocco, R.A., 12:37425
**Tavlarides, L.L.,** *See* Savastano, C.A., 12:37424
**Taylor, D.J.,** Advanced coherent Raman diagnostics for coal gasification streams, 12:36304 (RA;US)
**Taylor, D.W.,** Vegetation of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California, 12:37828 (R;US)
**Taylor, G.E. Jr.,** *See* Adams, M.B., 12:37605
**Taylor, J.H.,** [DNA repair and the regulation of replication]: Progress report for 1983-1986, 12:37863 (R;US)
**Taylor, L.M.,** *See* Stern, M., 12:38412
**Taylor, R.G.,** *See* Asher, R.C., 12:37576
**Taylor, R.J.,** *See* Mau, T.K., 12:38355
**Taylor, S.R.,** Surface chemical problems in coal flotation, 12:36234 (R;US)
**Tchernev, D.I.,** Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986, 12:37079 (R;US)
**Telesca, D.R.,** Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)
**Telewski, F.W.,** Current status of X-ray densitometry, 12:37764 (RA;US)
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
Thin-section technique for X-ray densitometric analysis of narrow tree-ring series, 12:38032 (RA;US)
**Teljing, Aa.,** *See* Sauli, J., 12:36344
**Teng, L.,** *See* Diebold, R., 12:37536
**Tengstroem, J.,** *See* Pellikka, M., 12:37085
**Tennant, D.A.,** Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo, 12:37842 (R;US)
**Teotia, A.P.S.,** Minority participation in new energy technologies: A case example of electric heat pumps, 12:37024 (R;US)
Projecting market demand for residential heat pumps, 12:37018 (R;US)
**Terauchi, H.,** *See* Samara, G.A., 12:37354
**Ternes, M.P.,** Single-family building retrofit performance monitoring protocol: Data specification guideline, 12:37077 (R;US)
**Terrill, D.L.,** A T-H method for heat exchanger network synthesis, 12:36412 (J;US)
**Terwilliger, E.,** *See* Schneider, C.A., 12:37880
**Tessier, L.,** Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects), 12:37761 (RA;US)
**Tetla, R.A.,** *See* Ng, E.K., 12:36957
**Teufel, L.W.,** *See* Warpinski, N.R., 12:36404
**Tewari, P.H.,** Microstructural studies of transparent silica gels and aerogels, 12:37322 (BA;US)
**Tham, C.,** Conclusions from the seminar, 12:36988 (RA;SE)
**Thayer, A.M.,** Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**The, H.L.,** *See* Fanger, H.U., 12:37563
**Theander, O.,** Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**Then, G.M.,** Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy, 12:37864 (R;DE;In German)
**Theofanous, T.G.,** Scaling of thermal mixing phenomena from one-fifth to full scale test facilities, 12:36857 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
*See* Wolf, L., 12:36888
**Thiel, P.A.,** *See* Chang, S.h., 12:37353
**Thiercelin, M.,** The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)
**Thimons, E.D.,** *See* Timko, R.J., 12:36342
**Thoburn, T.W.,** *See* Apol, A., 12:37678
**Thoma, B.P.,** Photoluminescence study of germanium-implanted gallium arsenide. Master's thesis, 12:37327 (R;US)

**Thomas, C.,** *See* Weitz, R., 12:37591, 12:37592
**Thomas, G.,** *See* Chen, J.K., 12:37224
*See* Ramesh, R., 12:37225
**Thomas, G.H.,** Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**Thomas, G.R.,** *See* Loewenstein, W.B., 12:36889
**Thomas, K.P.,** *See* Romanowksi, L.J. Jr., 12:36468
**Thomas, R.H.,** *See* McCaslin, J.B., 12:37558
**Thomas, R.L.,** *See* Heiple, C.R., 12:37233
*See* Wood, D.H., 12:37232
**Thomason, H.E.,** Trickle-flow solar collector; far higher efficiencies during cold weather, 12:36716 (BA;US)
**Thomason, H.J.L. Jr.,** *See* Thomason, H.E., 12:36716
**Thompson, A.C.,** Lubication and surface finish of extruded aluminum, 12:37218 (R;US)
**Thompson, J.D.,** *See* Hor, P.H., 12:37359
**Thompson, J.R.,** Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O/sub\ z/$, 12:37294 (R;US)
The influence of N-ion irradiation on superconducting TiN, 12:37212 (R;US)
*See* Christen, D.K., 12:37291
**Thompson, K.A.,** Feedback systems in the SLC, 12:37556 (R;US)
**Thompson, N.G.,** Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
**Thompson, R.B.,** Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
*See* Buck, O., 12:37266
*See* Clark, A.V. Jr., 12:37264
*See* Gray, T.A., 12:37273
*See* Ranjan, R., 12:37267
*See* Rehbein, D.K., 12:37271
**Thomsen, H.H.,** *See* Reeh, N., 12:38038
**Thomson, G.B.,** CP violation in K-short decay, 12:38143 (RA;US)
**Thorne, B.J.,** Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)
**Thornton, J.A.,** Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)
**Thorp, J.S.,** Some applications of phasor measurements to adaptive protection, 12:37511 (R;US)
*See* Horowitz, S.H., 12:36768
*See* Phadke, A.G., 12:36769
**Thorpe, A.N.,** Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986, 12:36312 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986, 12:36313 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, March 15, 1986-June 15, 1986, 12:36314 (R;US)
**Thun, R.,** Counting neutrinos at SLC, 12:38189 (RA;US)
**Tierney, J.,** *See* Shah, Y., 12:36261, 12:36262, 12:36263, 12:36264
**Tills, J.L.,** *See* Bergeron, K.D., 12:36912
**Timbre, K.,** *See* Kumar, S., 12:36762
**Timko, R.J.,** Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986, 12:36342 (R;US)
**Tischer, R.E.,** Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)
*See* Narain, N.K., 12:36282
**Tjoestheim, D.B.,** *See* Stensland, G., 12:36436
**Tobias, M.L.,** *See* Adams, R.E., 12:36898
**Todd, A.M.M.,** *See* Manickam, J., 12:38348
**Todd, J.A.,** *See* Carolan, R.A., 12:37231
**Todd, W.F.,** *See* Heitbrink, W.A., 12:37699
**Toecksberg, B.,** *See* Torisson, T., 12:37705
**Toemmeraas, P.J.,** Wild-life studies in the Alta watercourse. Survey report for 1982-1984, 12:37766 (R;NO;In Norwegian)
**Tokar, R.L.,** Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
**Tolman, E.L.,** TMI-2 accident scenario update, 12:36896 (RA;US)
*See* McCardell, R.K., 12:36895
**Tomassetti, G.,** Approach to a more rational use of energy in the textile area of Prato. Diffusion proposals and operative indications of intervention, 12:37141 (R;IT;In Italian)
**Tomkiewicz, M.,** *See* Yuan, R.K., 12:36642
**Tomkins, B.A.,** Preparation of radioactive "mixed" waste samples for measurement of RCRA [Resource Conservation and Recovery Act] organic compounds, 12:37371 (R;US)
**Tomlin, W.T.,** *See* Bulos, F., 12:37554
**Tomljanovich, D.A.,** *See* Bruggink, D.J., 12:37856
**Tong, G.T.,** Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987, 12:36584 (R;US)
**Toomre, J.,** Vector-array-processor computer equipment. Final report, 1 January-31 December 1985, 12:38052 (R;US)
**Toor, E.W.,** *See* Atlas, H., 12:36360
**Toqan, M.A.,** *See* Rini, M.J., 12:36361
**Torczynski, J.R.,** *See* Cummings, J.C., 12:36579
**Torisson, T.,** Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
**Torre, A.,** *See* Ciocci, F., 12:37479, 12:37480
*See* Dattoli, G., 12:37477, 12:37478
**Toth, K.S.,** Observation of /sup 149/Tm decay to /sup 149/Er levels and $\beta$-delayed proton emission, 12:38253 (J;US)
**Touboul, E.,** *See* Naceur, K.B., 12:36392
**Touboul, M.C.,** Charm hadroproduction in pp interactions at 400 GeV/c and 800 GeV/c, 12:38141 (RA;US)
**Toueg, S.,** *See* Koo, R., 12:38417
**Tovmassian, H.S.,** Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
**Towler, O.O.,** *See* Cook, J.R., 12:36514
**Tracey, T.R.,** *See* Tyner, C.E., 12:36668
**Traegner, U.K.,** *See* Suidan, M.T., 12:36327
**Traenkner, H.,** Integrated coverage of the condition of the forest. Multiple recording of data for an exemplary stand in Bavaria, 12:37794 (RA;DE;In German)
**Trangenstein, J.A.,** *See* Bell, J.B., 12:37502
**Trauttmansdorff, K.E.,** *See* Ettlinger, K., 12:37144
**Treadway, A.H.,** *See* Klett, R.D., 12:36533
**Treat, R.L.,** *See* Fow, C.L., 12:36527
**Trenholme, J.B.,** *See* Summers, M.A., 12:37487
**Treshow, M.,** Tolerance and susceptibility to air pollution, a new direction in sampling strategy: a case study of Pinus strobus L. in Acadia National Park, Maine, 12:37945 (RA;US)
**Tressler, R.E.,** *See* Tsai, Y., 12:37297
**Tricot, R.,** *See* Castro, R., 12:37256
**Trimble, J.L.,** Biomedical and Environmental Sciences Programs: Publications 1986, 12:37859 (R;US)
**Trubey, D.K.,** New buildup factor data for point kernel calculations, 12:38291 (R;US)
**Trudell, D.E.,** *See* Stohl, F.V., 12:36600
**Tsai, K.J.,** *See* Curtis, C.W., 12:36281
**Tsai, Y.,** Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
**Tsang, C.F.,** *See* Tsang, Y.W., 12:37829
**Tsang, M.B.,** *See* Bougault, R., 12:38254
**Tsang, Y.W.,** Channel model of flow through fractured media, 12:37829 (J;US)
**Tsertos, H.,** Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)
**Tsu, R.,** *See* McMahon, T.J., 12:37352
**Tsuge, A.,** Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
**Tsunoyama, S.,** Three-D neutronics model implementation into TRAC-BD1, 12:36877 (RA;US)
**Tubbs, D.L.,** *See* Schinder, P.J., 12:38205
**Tucholke, D.,** *See* Ishii, M., 12:36855
**Tucker, C.S.,** *See* Brown, K.J., 12:36962
**Tufeu, R.,** *See* Nieuwoudt, J.C., 12:37416
**Tuomisto, H.,** Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs, 12:36856 (RA;US)
**Turchi, P.E.A.,** Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method, 12:37245 (R;US)
**Turhollow, A.F.,** *See* Cushman, J.H., 12:36632
**Turley, R.S.,** *See* Lam, J.F., 12:38091
**Turlington, C.F.,** *See* Cheney, J.L., 12:37656
**Turner, L.R.,** Solution to workshop problem 6 (hollow sphere) in the shell approximation with EDDYNET-2D, 12:38322 (R;US)
**Turner, M.R.,** *See* Booker, C.P., 12:36870
**Turner, M.S.,** *See* Charlton, J.C., 12:38075

**Tuszewski, M.,** *See* Siemon, R.E., 12:38341
**Tuts, P.M.,** Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
**Tutu, N.K.,** *See* Ginsberg, T., 12:36911
**Twery, M.J.,** High-precision, low-cost dendrochronograph, 12:37454 (RA;US)
**Tyler, N.,** Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
**Tyner, C.E.,** The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system, 12:36668 (BA;US)
**Tynes, R.E.,** *See* Sabourin, P.J., 12:37976
**Tytko, S.F.,** *See* Kini, A.M., 12:37389
**Tzanos, C.P.,** Validation of an intermediate heat exchanger model for real time analysis, 12:36818 (R;US)
**Tzeng, C.,** *See* Nau, D., 12:38414

## U

**Ubani, E.A.,** *See* Evans, R.D., 12:36395
**Uberbacher, E.,** *See* Voet, D., 12:37861
**Uematsu, H.,** *See* Tsunoyama, S., 12:36877
**Uemura, M.,** *See* Nakatsuka, M., 12:37126
**Uetz, G.,** Energy saving by furnace automation, 12:37114 (RA;SE)
**Uherka, K.L.,** Assessment of radioisotope heaters for remote terrestrial applications, 12:36574 (R;US)
**Uhlenbusch, J.,** *See* Stefanov, B., 12:38354
**Ukai, O.,** *See* Tsuge, A., 12:36917
**Ulan, L.,** *See* Telewski, F.W., 12:38032
**Umstadter, D.,** Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
**Upadhyaya, B.R.,** Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)
*See* Kerlin, T.W., 12:36813
**Upchurch, S.B.,** *See* Oural, C.R., 12:37851
**Urbana, C.S.,** Floating emitter solar cell, 12:36641 (P;US)
**Uziel, M.,** *See* Vo-Dinh, T., 12:37386

## V

**Vaccaro, R.,** *See* Mazza, M., 12:36980
**Vaclavinek, J.,** Replacement of petroleum based fuels with lean gas in reheating furnaces, 12:37124 (RA;SE)
**Vaisnys, R.,** *See* Twery, M.J., 12:37454
**Vaitekunas, J.J.,** *See* Roberts, R.A., 12:37285
*See* Singh, J.P., 12:37292
**Valdez, G.D.,** *See* Murata, K.K., 12:36901
**Valentine, R.E.,** *See* Sparks, L.E., 12:37668
**Vallabhan, C.V.G.,** Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
*See* Lim, K., 12:36719
**Vallario, E.J.,** *See* Kenoyer, J.L., 12:36555
**Van Dam, J.W.,** *See* Demchenko, V.V., 12:38330
*See* Fu, Guoyong, 12:38329
**Van Deusen, P.C.,** Some applications of the Kalman filter to tree-ring analysis, 12:37760 (RA;US)
**van Dover, R.B.,** *See* Rudman, D.A., 12:37283
**Van Hoven, G.,** *See* Sparks, L., 12:38362
**Van Luik, A.E.,** Uranium in selected endorheic basins as partial analogue for spent fuel behavior in salt, 12:36478 (R;US)
**Van Verst, S.P.,** Microscopic analysis of projectile excitation for /sup 18/O+/ sup 64/Ni, 12:38276 (J;US)
**Van Voris, P.,** Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document, 12:37816 (R;US)
**Van Wagenen, H.D.,** *See* Sheehy, J.W., 12:37685
**Vanasse, G.A.,** *See* Barowy, W.M., 12:38018
**Vandamme, L.,** *See* Jeffrey, R.G., 12:36398
**Vandenborre, H.,** Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**Vanderborgh, N.E.,** *See* Williams, J.M., 12:36324
**Vandergrift, S.B.,** *See* Barnwell, T.O., 12:37839
**Vannucci, R.D.,** *See* Garcia, D., 12:37346
**Vanoll, K.H.,** *See* Chandrashekar, M., 12:36683
**Vary, J.P.,** [Intermediate/high energy probes and the structure of nuclei]: Final report, 12:38270 (R;US)
**Vassout, P.,** Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field, 12:38015 (TG;US)
**Veldhuizen, F.T.,** *See* Bulos, F., 12:37554
**Veldt, C.,** *See* Klug, W., 12:37598
**Venturini, E.L.,** Shock-modified transition metal ferrites, 12:37348 (R;US)
*See* Schirber, J.E., 12:37305
**Verburg, R.J.,** *See* Finch, G.L., 12:37972
**Verhoeven, J.D.,** *See* Jiles, D.C., 12:37269
**Vervuert, M.,** Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**Vianco, P.T.,** Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Vierinen, K.,** *See* Toth, K.S., 12:38253
**Vignati, A.,** *See* Bizzarri, U., 12:37482
**Vilenius, P.,** *See* Pellikka, M., 12:37085
**Villani, A.,** Spontaneous ideas about the speed of light, 12:38395 (R;BR)
**Vimmerstedt, J.P.,** *See* McClenahen, J.R., 12:37956
**Vine, E.,** *See* Bernard, M.J. III, 12:37016
**Vine, E.L.,** *See* Collins, N.E., 12:37017
**Vinella, S.,** *See* Tomassetti, G., 12:37141
**Vineyard, T.,** *See* Berry, L., 12:37026, 12:37078
**Vins, B.,** Standardized system for monitoring of air pollution effects on forests in the CSSR, 12:37795 (RA;DE;In German)
**Visser, H.,** Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)
Time-dependent responses of trees to weather variations an application of the Kalman filter, 12:37954 (RA;US)
**Viswanathan, S.,** Aircraft battery state of charge and charge-control system. Interim report, 1 July 1985-30 June 1986, 12:36940 (R;US)
**Viswanathan, V.K.,** *See* Knapp, C.E., 12:37484
**Vitek, J.M.,** Diffraction effects from interfaces, 12:37211 (R;US)
**Vo-Dinh, T.,** Surface-enhanced Raman analysis of Benzo[A]Pyrene-DNA adducts on silver-coated cellulose substrates, 12:37386 (J;US)
*See* Suter, G.W., 12:37382
**Voelker, R.P.,** Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**Voet, D.,** Structure of yeast inorganic pyrophosphastase: A progress report, 12:37861 (R;US)
**Vogt, M.,** *See* Bogner, J., 12:37824
**Voigt, M.J.A. de,** Energy correlations of $\gamma$-rays from superdeformed states in $Z=66$ and 68 isotopes; multipolarities in $^{152}Dy$, 12:38258 (BA;DE)
**Vokou, D.,** *See* Margaris, N.S., 12:36630
**Volin, K.J.,** *See* Saboungi, M., 12:37246
**von Goeler, S.,** *See* Hill, K.W., 12:38346
**von Riesemann, W.A.,** Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
**Vook, R.W.,** *See* Lloyd, J.N., 12:37238
**Vyas, A.,** *See* Millar, M., 12:36416

## W

**Waddell, R.K.,** *See* Dixon, G.L., 12:36509
**Wade, D.C.,** *See* Bruggink, D.J., 12:37856
**Waeaenaenen, M.,** *See* Jaemsae, S., 12:37091
**Wagner, A.,** *See* Diehl, J.F., 12:37817
**Wagner, A.F.,** Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory, 12:37387 (R;US)
**Wagner, B.S.,** Keeping warm: findings from the Kansas City warm room retrofit project, 12:37058 (RA;US)
**Wagner, C.L.,** *See* Rockefeller, G.D., 12:36767
**Wagner, R.J.,** *See* Allison, C.M., 12:36908
**Wagner, S.,** Forward-backward asymmetry for b and c quarks, 12:38172 (RA;US)
**Wagner, W.,** *See* Tsertos, H., 12:38095
**Wagoner, S.R.,** *See* Dallman, R.J., 12:36919
**Waide, J.J.,** *See* Henderson, R.F., 12:37966
**Wakaizumi, S.,** *See* Bigi, I.I., 12:38204
**Wakefield, V.A.,** *See* Peterson, D.L., 12:37946
**Walcott, K.J.,** *See* Thompson, N.G., 12:36458
**Walecka, J.D.,** 35 years of electron scattering, 12:38271 (R;US)

Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Wales, D.,** *See* Horn, F.L., 12:36780
**Walker, J.F.,** *See* Buckley-Golder, D.H., 12:37004
**Walker, R.D.,** *See* Williams, J.M., 12:36324
**Walker, R.L.,** *See* Inn, K.G.W., 12:37577
**Walker, S.L.,** *See* Tennant, D.A., 12:37842
**Wall, S.M.,** *See* John, W., 12:37667
**Wallace, D.C.,** On the role of density fluctuations in the entropy of a fluid, 12:38311 (J;US)
**Wallace, J.A.,** *See* Reeves, S.R., 12:36444
**Wallingford, K.M.,** NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US)
**Walls, C.A.,** *See* Lauf, R.J., 12:37378
**Walsh, D.W.,** *See* Sundell, R.E., 12:37235
**Walsh, H.D.,** *See* Sundell, R.E., 12:37235
**Walsh, J.E.,** *See* Ciocci, F., 12:37479, 12:37480
**Walt, D.R.,** *See* Jordan, D.M., 12:37414
**Walter, E.,** Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)
**Walton, O.R.,** *See* Britton, K., 12:38048
**Walukiewicz, W.,** Mechanism of Schottky barrier formation: The role of amphoteric native defects, 12:37357 (J;US)
**Walz, D.R.,** *See* Bulos, F., 12:37554
**Wang, C.S.,** Particle evolution in MHD systems, 12:37005 (R;US)
**Wang, D.,** *See* Rapaport, J., 12:38241
**Wang, H.C.,** *See* John, W., 12:37667
**Wang, J.M.,** *See* Decker, G., 12:37540
**Wang, K.Y.,** Rapid heating of gas/small particle mixture, 12:37410 (J;US)
*See* Bohn, M.S., 12:36667
**Wang, X.W.,** *See* Harmon, B.N., 12:37250
**Wang, Z.Y.,** *See* Almenas, K., 12:36846
**Ward, A.V.,** *See* Buckley-Golder, D.H., 12:37004
**Ward, B.,** Biodegradation and bioconversion of coals by fungi: Technical report No. 7 for the period March 1, 1987-May 31, 1987, 12:36315 (R;US)
**Ward, B.F.L.,** *See* Jadach, S.T., 12:38169
**Ward, G.F.,** *See* Spicer, C.W., 12:37686
**Ward, K.J.,** *See* Balfe, C.A., 12:37427
*See* Brinker, C.J., 12:37316
**Ward, R.A.,** *See* Bauer, R.W., 12:38247
**Wardlaw, D.M.,** *See* Wagner, A.F., 12:37387
**Waring, R.H.,** New analysis of branches, boles, and roots for predicting historical changes in photosynthesis, respiration, and carbon allocation below ground, 12:37733 (RA;US)
**Warner, B.E.,** An overview of copper-laser development for isotope separation, 12:36481 (R;US)
**Warpinski, N.R.,** In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)
**Warshay, M.,** Status of commercial fuel cell powerplant system development, 12:37012 (R;US)
**Wasan, D.T.,** Enhanced oil recovery through in-situ generated surfactants augmented by chemical injection: First annual report for the period October 1985-September 1986, 12:36380 (R;US)
**Washburn, J.,** *See* Liliental-Weber, Z., 12:37340
**Washington, K.E.,** *See* Bergeron, K.D., 12:36912
*See* Murata, K.K., 12:36901
**Washington, L.A.,** The Thermal Flash Protection System, low pass filter JN175666A1, 12:37515 (R;US)
**Wasielewski, M.R.,** Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules, 12:36622 (R;US)
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
**Wastenson, L.,** *See* Holmgren, B., 12:37730
**Waterland, L.R.,** *See* Castaldini, C., 12:36606, 12:36607
**Watkins, R.D.,** Development of CABAL [calcium-boro-aluminate] glasses for use in lithium ambient-temperature batteries, 12:36945 (R;US)
**Watson, C.A.,** The Cliper Data Acquisition System, 12:37594 (R;US)
**Watson, R.H.,** Thermabilt energy efficient residential construction research, demonstration and technology transfer, 12:37059 (RA;US)
**Watt, R.G.,** Pellet injection on the ZT-40M reversed field pinch, 12:38386 (J;US)
**Weast, G.J.,** *See* Imamura, J.N., 12:38074
**Weaver, N.,** *See* Anderson, J., 12:36670
**Weaver, W.L. III,** Status of the TRAC-BWR Program, 12:36865 (RA;US)
**Webb, D.H.,** *See* Bruggink, D.J., 12:37856
**Webb, M.L.,** Probing the direct step of relativistic heavy ion fragmentation: ($^{12}C$, $^{11}B+p$) at 2.1 GeV/nucleon with C and $CH_2$ targets, 12:38239 (R;US)
**Weber, E.R.,** *See* Liliental-Weber, Z., 12:37340
**Weber, E.T.,** Transient survivability of LMR oxide fuel pins, 12:36820 (R;US)
**Weber, G.,** *See* Kanzleiter, T., 12:36902
**Weber, J.A.,** *See* Gates, D.M., 12:36627
**Weber, P.G.,** *See* Watt, R.G., 12:38386
**Weeren, H.O.,** *See* McDaniel, E.W., 12:36502
**Wegley, H.L.,** *See* Barnard, J.C., 12:36736
**Wehrhahn, A.-K.,** Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery, 12:36386 (R;DE;In German)
**Weijo, R.O.,** *See* Drost, M.K., 12:36939
**Weiner, E.O.,** Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**Weinstein, A.,** Reconstructing heavy long-lived neutral leptons, 12:38180 (RA;US)
**Weir, A.,** Summary of work on QCD backgrounds to $Z^0 \rightarrow H^0$ anti ell ell, 12:38185 (RA;US)
**Weirick, L.J.,** The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system, 12:36676 (BA;US)
**Weisbin, C.R.,** *See* Goldstein, M., 12:36808
**Weiss, P.A.,** UPTF test results--first three separate effects tests, 12:36862 (RA;US)
**Weitz, R.,** Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)
**Weitzman, D.J.,** *See* Schwope, A.D., 12:37449, 12:37451
**Welcome, M.,** *See* Bell, J.B., 12:37502
**Weldon, W.F.,** *See* Persad, C., 12:37200
**Weller, J.D.,** Parametric investigation of soot behavior and other emissions in a gas-turbine combustor. Master's thesis, 12:36461 (R;US)
**Wen, C.,** *See* Shah, Y., 12:36261, 12:36262, 12:36263, 12:36264
**Wen, W.W.,** A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)
*See* Melkus, T.G., 12:36292, 12:36293
**Wendelin, T.,** *See* Anderson, J., 12:36670
**Wender, I.,** *See* Shah, Y., 12:36261, 12:36262, 12:36263, 12:36264
**Wenner, D.,** *See* Sebesta, Z., 12:37145
**Wennerhag, P.,** *See* Linderstad, H., 12:37021
**Wenzel, W.A.,** Accelerator facilities in the 100-1000 TeV range, 12:37537 (BA;US)
**Wesely, M.L.,** *See* Hicks, B.B., 12:37648
**Wessels, B.W.,** *See* Sammells, A.F., 12:36578
**Westbrook, C.K.,** *See* Keller, J.O., 12:37523
**Westman, L.,** Thinning out of the tree crown - what is hidden in that integrated measure of forest damage, 12:37939 (RA;DE)
**Wexler, B.L.,** *See* Shipman, J.D. Jr., 12:37490
**Weyand, J.D.,** *See* Ellingson, W.A., 12:37284
**Whaley, S.L.,** *See* Fischer, J.P., 12:37979
*See* Wolff, R.K., 12:37961
**Wheatley, P.D.,** *See* Dallman, R.J., 12:36919
**Whitaker, N.,** Numerical solution of the Hele-Shaw equations, 12:38103 (R;US)
**Whitby, E.R.,** *See* Seigneur, C., 12:37643
**Whitby, K.T.,** *See* Seigneur, C., 12:37643
**White, A.F.,** Carbon and isotopic mass balance models of Oasis Valley-Fortymile Canyon ground water basin, southern Nevada, 12:37823 (J;US)
**White, C.L.,** *See* Chatterjee, A., 12:37261
**White, C.W.,** Oxidation of Ge-implanted silicon, 12:37332 (R;US)
**White, D.,** *See* Berry, L., 12:37026
**White, D.H.,** *See* Ahrens, L.A., 12:38150
**White, D.L.,** *See* Berry, L., 12:37078
**White, E.H.,** *See* LeBlanc, D.C., 12:37805
**White, G.L.,** *See* Rowley, R.L., 12:37420
**White, N.E.,** *See* Haberl, F., 12:38073
**White, R.M.,** *See* Fackler, O., 12:38198
**White, S.,** *See* Wagner, S., 12:38172
**White, V.,** *See* Dorries, T., 12:38408
*See* Heinicke, P., 12:38410
**White, V.F.,** *See* Eatough, D.J., 12:37645
**White, W.B.,** Spectroscopic investigations of glass structure: Final report for the period April 1, 1984-December 31, 1986, 12:37334 (R;US)

**Whitehead, W.S.,** The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)
*See* Holditch, S.A., 12:36440, 12:36441
**Whitemore, J.B.,** *See* Bown, J.R., 12:36425
**Whitesel, R.N.,** *See* Chu, B.B., 12:36891
**Whiton, J.C.,** Growth-rate trends of pines since 1930 in the northeastern United States, 12:37944 (RA;US)
**Wicks, D.E.,** *See* Mc Fall, K.S., 12:36447
**Widgoff, M.,** A research program in experimental high energy physics: Task B, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38120 (R;US)
**Widrow, L.M.,** *See* Hill, C.T., 12:38225
**Wiesenfeld, K.,** Amplitude calculation near a period-doubling bifurcation: An example, 12:37470 (J;US)
**Wiita, P.J.,** *See* Schinder, P.J., 12:38205
**Wild, U.P.,** *See* Suter, G.W., 12:37382
**Wilde, G.M.,** *See* Selkowitz, S.E., 12:37072
**Wildman, D.J.,** *See* Ekmann, J.M., 12:36350
**Wilke, J.G.,** *See* Phillips, A.M., 12:36448
**Wilkerson, J.F.,** *See* Bowles, T.J., 12:38152
*See* Knapp, D.A., 12:38236
**Wilkowski, G.M.,** Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986, 12:36804 (R;US)
**Williams, D.C.,** *See* Bergeron, K.D., 12:36912
**Williams, F.L.,** *See* Venturini, E.L., 12:37348
**Williams, J.M.,** Host/guest structure concept and the thermolysis of coal, 12:36324 (BA;NL)
*See* Kini, A.M., 12:37389
*See* Thompson, J.R., 12:37212
**Williams, J.S.,** *See* Ortiz, S., 12:36564
**Williams, M.D.,** Solar power absorption in a glass tube, 12:36704 (R;US)
**Williams, M.L.,** Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II, 12:36777 (R;US)
**Williams, R.,** *See* Umstadter, D., 12:38365
**Williams, R.K.,** *See* Bentley, J., 12:37290
**Williams, T.A.,** Analysis of solar thermal concepts for electricity generation, 12:36672 (BA;US)
**Williamson, D.L.,** *See* Ryan, M.A., 12:37356
*See* Venturini, E.L., 12:37348
**Willis, Y.A.,** The need for public education: Nuclear waste disposal programs, 12:36545 (BA;US)
**Willson, R.F.,** *See* Lang, K.R., 12:38054, 12:38055, 12:38056
**Wilmarth, P.A.,** *See* Toth, K.S., 12:38253
**Wilson, B.L.,** The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Wilson, B.W.,** *See* Gray, R.H., 12:36367
**Wilson, C.N.,** Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
**Wilson, D.S.,** *See* Pellegrin, J.L., 12:37555
**Wilson, J.H.,** *See* Dinsmore, T.V., 12:36289
*See* Pechan, E.H., 12:36764
*See* Wright, A.L., 12:36900
**Wilson, R.B.,** *See* Tong, G.T., 12:36583, 12:36584
**Wilson, R.M.,** Statistical aspects of solar flares, 12:38062 (R;US)
**Wilson, T.,** *See* Shen, L., 12:37057
**Wilson, W.E.,** *See* Dixon, G.L., 12:36509
**Winans, R.E.,** *See* Hayatsu, R., 12:36294
**Winkel, B.V.,** *See* Severud, L.K., 12:37505
**Winkelmann, I.,** Results of the activity measurements after the reactor accident in Chernobyl, 12:37710 (R;DE;In German)
**Winkler, F.J.,** Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG, 12:36872 (RA;US)
*See* Schneider, K., 12:36871
**Winkler-Seifert, A.,** *See* Kontic, R., 12:37602, 12:37754
**Winn, C.B.,** *See* Bleem, J., 12:36694
**Winnick, J.,** Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
**Winstein, B.,** CP and other experimental probes of electroweak phenomena, 12:38127 (RA;US)
**Winston, R.,** *See* Suresh, D., 12:36710
**Winter, B.,** Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
**Withers, H.P.,** Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
**Witherspoon, P.A.,** *See* Pyrack-Nolte, L.J., 12:38043
**Witte, W.G.,** Baseline tensile tests of composite materials for LDEF (Long duration exposure facility) exposure, 12:37342 (R;US)
**Wittlin, M.R.,** *See* Mohney, E.V., 12:38400
**Witzig, W.F.,** Evaluation of protective action risks, 12:36554 (R;US)
**Woelk, G.,** *See* Uetz, G., 12:37114
**Woerner, R.,** *See* Fackler, O., 12:38198
**Wolf, L.,** Application of engineering and multi-dimensional, finite difference codes to HDR thermal mixing experiments, 12:36888 (RA;US)
*See* Kanzleiter, T., 12:36902
**Wolfert, K.,** CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
**Wolff, R.K.,** Lung retention of inhaled $^{14}$C-BaP and $^{14}$C-NP when adsorbed on carbon particles, 12:37967 (RA;US)
Technique for aerosol deposition restricted to the nose in Beagle dogs, 12:37961 (RA;US)
*See* Mauderly, J.L., 12:36476
*See* Muggenburg, B.A., 12:37924
*See* Sun, J.D., 12:37968
**Wolfsberg, K.,** *See* Norris, A.E., 12:36520
**Wollam, E.J.,** *See* Wood, R.L., 12:36715
**Womack, J.D.,** *See* McMillen, R.T., 12:37671
**Wong, C.C.,** *See* Berman, M., 12:36915
**Wong, H.V.,** *See* Berk, H.L., 12:38334
**Wong, J.,** *See* Gregory, E., 12:37255
**Wong, K.M.,** *See* Noshkin, V.E., 12:37852
**Wong, L.S.,** *See* Kiel, J.L., 12:38012
**Wood, B.D.,** *See* Nelson, D.J., 12:36699
**Wood, D.,** Summary of work on $Z^0 \rightarrow$ Higgs neutrinos antineutrinos, 12:38182 (RA;US)
**Wood, D.H.,** Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate, 12:37232 (R;US)
**Wood, P.A.,** Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**Wood, R.L.,** Preliminary investigation of a lightweight inflated conical concentrator for space applications, 12:36715 (BA;US)
**Woodruff, D.M.,** Density-of-states calculations within the recursion method, 12:38303 (J;US)
**Woodruff, S.D.,** *See* Anderson, R.J., 12:36357
**Woodward, A.E.,** Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**Woody, M.C.,** *See* Chambers, R.R. Jr., 12:36297
**Wooton, R.O.,** *See* Gieseke, J.A., 12:36909
**Wootton, A.J.,** *See* Evans, T.E., 12:38380
**Worbes, M.,** Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)
**Workhoven, R.M.,** *See* Graham, R.H., 12:36566
**Worledge, D.H.,** *See* Chu, B.B., 12:36891
**Worth, B.,** *See* Kolar, W., 12:36884
**Wouters, A.W.,** *See* Schwob, J.L., 12:38347
**Wright, A.L.,** Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)
**Wright, B.,** *See* Siemon, R.E., 12:38341
**Wright, L.E.,** Calculation of pair production by 10 and 20 MeV photons, 12:38275 (J;US)
**Wright, L.J.,** *See* Maxwell, R.L., 12:36567
**Wright, R.F.,** RAIN project. Annual report for 1984, 12:37622 (R;NO)
**Wright, R.S.,** Second performance audit of inspection and maintenance calibration gases, 12:37637 (R;US)
**Wrobel, P.J.,** *See* Barron, T.S., 12:37143
**Wrobel, T.F.,** On ion induced hard errors in dielectric structures, 12:37516 (R;US)
**Wu, C.H.,** *See* Choo, Y.K., 12:36456
**Wu, C.L.,** Empirical evidences for fermion dynamical symmetries in nuclei, 12:38288 (BA;US)
**Wu, E.J.,** Chemical form and leachability of inorganic trace elements in coal ash: Final report, 12:36328 (R;US)
**Wu, M.K.,** *See* Hor, P.H., 12:37359
**Wulff, W.,** BWR plant analyzer development at BNL, 12:36869 (RA;US)
*See* Cheng, H.S., 12:36811
**Wurden, G.A.,** *See* Watt, R.G., 12:38386

## X

**Xu, Z.,** Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Xue, P.Y.,** *See* Branco, G.C., 12:38211

## Y

**Yamaguchi, D.K.,** Development of old-growth Douglas-fir forests northeast of Mount St. Helens, Washington, following an A.D. 1480 eruption, 12:37750 (RA;US)
**Yamaguchi, Yoshio,** Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984, 12:38232 (R;US)
**Yamazaki, A.,** *See* Nagao, S., 12:37879
**Yamin, P.,** *See* Sullivan, M.W., 12:38151
**Yan, L.,** *See* Branagan, P.T., 12:36457
**Yang, D.C.,** Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87, 12:36236 (R;US)
**Yang, Hung-Duen,** Superconductivity, magnetism, and charge density wave formation in ternary compounds with the $Sc_5Co_4Si_{10}$-type structure, 12:37338 (R;US)
**Yanosky, T.M.,** Progress in the image analysis of tree rings, 12:38033 (RA;US)
**Yap, B.K.,** Atmospheric radiance profile codes. Technical report, 12:38085 (R;US)
**Yarbrough, D.W.,** *See* McElroy, D.L., 12:37023
**Yates, B.W.,** *See* Arko, A.J., 12:37204
**Yeh, H.C.,** Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University, 12:37619 (RA;US)
*See* Chen, B.T., 12:36337, 12:37612, 12:37614
*See* Cheng, Y.S., 12:37613, 12:37960
*See* Cuddihy, R.G., 12:37970
*See* Newton, G.J., 12:37716
*See* Su, Y.F., 12:37713
*See* Wolff, R.K., 12:37967
**Yen, S.P.S.,** Materials performance analysis of perfluorocarbon liquid/plastic film capacitors, 12:37368 (BA;US)
**Yen, Teh Fu,** Microbial screening test for lignite degradation: Quarterly progress report No. 10 for the period April-June 1987, 12:36311 (R;US)
**Yoder, R.,** Overview of the heat loss study for the Hood River Conservation Project, 12:37060 (RA;US)
**Yokosawa, Akihiko,** Recent results on polarizations and the present status of the Fermilab polarized beams, 12:38110 (R;US)
**Yoon, T.,** Recent results from ARGUS, 12:38136 (RA;US)
**York, R.C.,** *See* Grunder, H.A., 12:37532
**Yoshida, H.,** Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide, 12:38010 (J;US)
**Yoshikawa, Kozo,** System for removing contaminated surface layers, 12:36807 (TG;US)
**Yost, A.B. II,** Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)
*See* Salamy, S.P., 12:36434
**Young, C.E.,** *See* Pellin, M.J., 12:38296
**Young, E.R.,** *See* Doyle, S.M., 12:38083
**Young, F.,** Investigation of rock drilling processes with diamond cutters of peg shape, 12:36374 (RA;DE;In German)
*See* Hartmann, A., 12:36375
**Young, R.M.,** Nusselt number correlations for heat transfer to small spheres in thermal plasma flows, 12:37445 (J;US)
**Younkin, J.M.,** *See* Gray, J.R., 12:36573
**Yu, Kin Man,** Ion beam characterization of thin film metal/GaAs interface reactions, 12:37513 (R;US)
**Yu, T.U.,** *See* Rini, M.J., 12:36361
**Yuan, R.K.,** Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**Yuan, V.W.,** *See* Bowman, C.D., 12:38284
**Yuchien Yuan, Marchetti, S.,** *See* Newsom, P.C., 12:36553
**Yuen, W.W.,** *See* Wang, K.Y., 12:37410
**Yugo, J.J.,** *See* Swain, D.W., 12:38374
**Yun, H.,** *See* Squattrito, P.J., 12:37257

## Z

**Zagrodnik, J.P.,** Zinc-bromine battery development, 12:36946 (R;US)
**Zaininger, H.W.,** Electrical behavior of wind power stations: Final report, 12:36646 (R;US)
**Zang, T.A.,** *See* Krist, S.E., 12:37495
**Zarkova, L.,** *See* Stefanov, B., 12:38354
**Zarochak, M.F.,** Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)
*See* Pennline, H.W., 12:37412
**Zaromb, S.,** Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
*See* Stetter, J.R., 12:37707
**Zeikus, J.G.,** *See* Goodwin, S., 12:36604
*See* Kerby, R., 12:38008
**Zeile, H.J.,** The future of nuclear power, 12:36975 (R;US)
**Zeilik, M.,** *See* Baber, D.N., 12:38072
**Zethraeus, B.,** *See* Vaclavinek, J., 12:37124
**Zey, J.N.,** Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**Zhang, X.,** *See* Turchi, P.E.A., 12:37245
**Zheng, Q.,** *See* Reiter, E.R., 12:37725
**Zheng, Z.,** *See* Ewy, R.T., 12:38044
**Zhou, S.,** Trace-driven simulation study of dynamic load balancing. Technical report, 7 August 1984-6 August 1987, 12:38416 (R;US)
**Ziegler, N.F.,** Recent electronic improvements to the Oak Ridge 25URC accelerator, 12:37547 (R;US)
**Ziessel, R.,** *See* Lehn, J.M., 12:36576
**Zimmerman, P.,** Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Zimmerman, P.W.,** Performance issues in solar thermal energy transport systems, 12:36655 (R;US)
**Ziph, B.,** Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)
**Zipperian, T.E.,** GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature ($T > 300°C$), power electronic applications, 12:37517 (R;US)
*See* Hughes, R.C., 12:37519
**Zirngiebl, E.,** *See* Hor, P.H., 12:37359
**Zisman, M.S.,** ZAP and its application to the optimization of synchrotron light source parameters, 12:37560 (R;US)
**Zuber, M.D.,** The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**Zuurbier, S.P.A.,** *See* Hollander, F., 12:37110
**Zygarlicke, C.J.,** *See* Schobert, H.H., 12:36323

# SUBJECT INDEX

The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms (DOE/TIC-7000). Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

**SUBJECT DESCRIPTOR**
**Qualifier**
Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

## A


**A CODES**
Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)

**ABIES**
*See FIRS*

**ABNORMALITIES (CHROMOSOMAL)**
*See CHROMOSOMAL ABERRATIONS*

**A-BOMB SURVIVORS**
**Radiation Doses**
Notes on the effect of dose uncertainty, 12:37902 (R;US)

**ABSORBED DOSES**
*See RADIATION DOSES*

**ABSORBERS (SOLAR)**
*See SOLAR ABSORBERS*

**ABSORPTION REFRIGERATION CYCLE**
**Market**
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)

**ACCELERATOR FACILITIES**
*See also STANFORD LINEAR COLLIDER*
**Design**
Accelerator facilities in the 100-1000 TeV range, 12:37537 (BA;US)
**Planning**
Accelerator facilities in the 100-1000 TeV range, 12:37537 (BA;US)
Conventional 20-TeV, 10-Tesla, p/sup +-/p colliders, 12:37536 (BA;US)

**ACCELEROMETERS**
**Frequency Response Testing**
Characterization of accelerometer mountings in shock environments, 12:37579 (R;US)
**Mechanical Vibrations**
Characterization of accelerometer mountings in shock environments, 12:37579 (R;US)

**ACCESS DENIAL SYSTEMS**
*See ENTRY CONTROL SYSTEMS*

**ACCIDENTAL INTAKE**
*See ACCIDENTS*

**ACCIDENTAL IRRADIATION**
*See RADIATION ACCIDENTS*

**ACCIDENTS**
*See also RADIATION ACCIDENTS*
*REACTOR ACCIDENTS*
**Probability**
Safety and optimal prevention of platform accidents, 12:36413 (R;NO)
**System Failure Analysis**
Using operating experience and a cause coding tree to identify improvements for nuclear process control, 12:36825 (R;US)

**ACCRETION DISKS**
**Mathematical Models**
Collisional dynamics of perturbed particle disks in the solar system. Annual technical progress report, 12:38061 (R;US)

**ACES**
*See QUARKS*

**ACETATES**
**Phosphorescence**
External heavy-atom effect in room-temperature phosphorescence, 12:37382 (J;US)

**ACID CARBONATES**
**Thermodynamic Properties**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)

**ACID ELECTROLYTE FUEL CELLS**
**Commercialization**
Status of commercial fuel cell powerplant system development, 12:37012 (R;US)

**ACID RAIN**
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)
Review of the national ambient air-quality standards for particulate matter: updated assessment of scientific and technical information. Addendum to the 1982 OAQPS (Office of Air Quality Planning and Standards) staff paper. Final report, 12:37727 (R;US)
**Atmospheric Chemistry**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**Biological Effects**
Effects of acid precipitation on plant diseases, 12:37999 (R;US)
Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Corrosive Effects**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Environmental Effects**
Characterization of historical growth patterns in declining red spruce trees, 12:37805 (RA;US)

**Inventories**
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**Mathematical Models**
Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain, 12:37659 (R;US)
**Surveys**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)
**Water Pollution**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)
**Water Quality**
RAIN project. Annual report for 1984 (Norway), 12:37622 (R;NO)

**ACRYLONITRILE**
**Air Pollution Control**
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)

**ACTINIUM 228**
**Radioecological Concentration**
An improved method for the simultaneous determination of $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$ in water, soils and sediments, 12:37848 (R;US)

**ACTIVATED CARBON**
**Sorptive Properties**
Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)

**ACTIVITY TRANSPORT**
*See RADIOACTIVITY TRANSPORT*

**ACTUATORS**
**Design**
The application of variable explosive chamber testing to actuator testing, 12:37583 (R;US)
**Performance Testing**
The application of variable explosive chamber testing to actuator testing, 12:37583 (R;US)

**ADA**
Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report, 12:37186 (R;US)

**ADAPTIVE INTRUSION DATA SYSTEMS**
*See INTRUSION DETECTION SYSTEMS*

**ADENOCARCINOMAS**
*See CARCINOMAS*

**ADENOSINE TRIPHOSPHATE**
*See ATP*

**ADSORBENTS**
*See also ACTIVATED CARBON*
*SILICA GEL*
**Performance Testing**
High-temperature desulfurization of coal gas for gas turbine and fuel cell application, 12:36259 (RA;US)
**Regeneration**
High-temperature desulfurization of coal gas for gas turbine and fuel cell application, 12:36259 (RA;US)

**AEROSOLS**
*See also RADIOACTIVE AEROSOLS*
**Chemical Analysis**
Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
**Diffusion**
Deposition of ultrafine particles on a human nasal cast, 12:37960 (RA;US)
**Dynamics**
Simulation of aerosol dynamics: a comparative review of mathematical models, 12:37643 (R;US)
**Health Hazards**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Inhalation**
Deposition of ultrafine particles on a human nasal cast, 12:37960 (RA;US)
**Sampling**
Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)

**AGGLOMERATION**
**Comparative Evaluations**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)

**AGGREGATION**
*See AGGLOMERATION*

**AGRICULTURAL RESIDUES**
*See AGRICULTURAL WASTES*

**AGRICULTURAL WASTES**
*See also MANURES*
**Waste Processing**
Algal biomass from farm waste. A pilot plant study, 12:36628 (R;GB)

**AGRICULTURE**
*See also DAIRY INDUSTRY*
**Harvesting**
New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
**Resource Conservation**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)
**Thermal Waters**
Agricultural utilization of thermal waters - demonstration program. Pt. 2. Detailed scheme of the demonstration program 'Agricultural utilization of geothermal waters in Waltersdorf' and establishment of an individual investigation program. Final report, 12:37144 (R;DE;In German)
**Waste Heat Utilization**
Agricultural utilization of thermal waters - demonstration program. Pt. 2. Detailed scheme of the demonstration program 'Agricultural utilization of geothermal waters in Waltersdorf' and establishment of an individual investigation program. Final report, 12:37144 (R;DE;In German)

**AIR**
**Heating**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**Sorptive Properties**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**Transfrontier Contamination**
Results of the activity measurements after the reactor accident in Chernobyl, 12:37710 (R;DE;In German)

**AIR CONDITIONERS**
*See also SOLAR AIR CONDITIONERS*
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Field Tests**
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)

**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Thermodynamic Properties**
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)

**AIR CONDITIONING**
**Air Flow**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Mathematical Models**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
**Pressure Measurement**
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Temperature Control**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
**Thermal Comfort**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Working Conditions**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)

**AIR FLOW**
**Thermal Comfort**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
**Walls**
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Windows**
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)

**AIR HEATERS**
**Indoor Air Pollution**
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)

**AIR POLLUTION**
*See also INDOOR AIR POLLUTION*
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
Interspecies dosimetry of reactive gases, 12:37996 (R;US)
Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)
**Antioxidants**
Pulmonary antioxidants, 12:38004 (R;US)
**Atmospheric Circulation**
Analysis and evaluation of statistical coastal fumigation models, 12:37640 (R;US)
**Bibliographies**
EPA (Environmental Protection Agency) Publications Bibliography. Quarterly abstract bulletin. Quarterly report, 12:36968 (R;US)
**Biological Effects**
Growth-rate trends of pines since 1930 in the northeastern United States, 12:37944 (RA;US)
**Biological Indicators**
Southern forest growth trends: air pollution influence studies and tree-ring analysis, 12:37943 (RA;US)
Time-dependent responses of trees to weather variations an application of the Kalman filter, 12:37954 (RA;US)
Trace element analysis of wood, a tool for monitoring air pollution, 12:37796 (RA;DE)
Tree-growth, ARMA modelling and pollution, 12:37955 (RA;US)
**Data Analysis**
National air-pollutant-emission estimates, 1940-1985. Final report, 12:37666 (R;US)
Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
**Data Compilation**
Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
**Environmental Effects**
Exemplary assessment of forest monitoring from air pollution. Analysis of diameter increase variations, 12:37799 (RA;DE;In German)
**Gas Analysis**
Second performance audit of inspection and maintenance calibration gases, 12:37637 (R;US)
**Institutional Factors**
Fence: where the community and the workplace meet, 12:37889 (R;US)
**Long-Range Transport**
Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation, 12:37621 (R;NO;In Norwegian)
**Manuals**
Environmental Assessment Technical Assistance Handbook, 12:36964 (R;US)
**Mathematical Models**
Air-pollution models as descriptors of cause-effect relationships, 12:37638 (R;US)
Analysis and evaluation of statistical coastal fumigation models, 12:37640 (R;US)
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)
Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version), 12:37663 (R;US)
Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)
ROADWAY: a numerical model for predicting air pollutants near highways. User's guide. Final report, 12:37624 (R;US)
Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain, 12:37659 (R;US)
Simulation of aerosol dynamics: a comparative review of mathematical models, 12:37643 (R;US)
Sources and evaluation of uncertainty in long-range transport models, 12:37691 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 1. Adaptation of the mechanism. Final report, March 1986-February 1987, 12:37660 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 2. Guidelines for using the mechanism. Final report, March 1986-February 1987, 12:37661 (R;US)
**Measuring Methods**
Episodic coincident air-quality and precipitation measurements in an urban setting, 12:37664 (R;US)
Remote measurement of sulfur dioxide emissions using an ultraviolet-light-sensitive video system, 12:37644 (R;US)
**Pollution Regulations**
Handbook for the review of excess emission reports. Final report, 12:37681 (R;US)
**Pollution Sources**
National air-pollutant-emission estimates, 1940-1985. Final report, 12:37666 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)
Southern forest growth trends: air pollution influence studies and tree-ring analysis, 12:37943 (RA;US)
Survey to assess the effects of atmospheric deposition on forest vegetation, 12:37783 (RA;DE)

**Soot**
Instrument for the quasi-continuous determination of the atmospheric soot content, 12:37525 (R;DE;In German)
**Standards**
Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)
**Stationary Pollutant Sources**
Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)
**Surveys**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)

**AIR POLLUTION ABATEMENT**
*Use this term for items that involve the prevention of formation of pollutants at the source.*
Application for certification 1987 model year heavy-duty engines, 12:37168 (R;US)
Application for certification 1987 model year heavy-duty engines - Caterpillar, 12:37169 (R;US)
Application for certification 1987 model year heavy-duty engines - Chrysler, 12:37170 (R;US)
Application for certification 1987 model year heavy-duty engines - Mitsubishi Motors corporation, 12:37171 (R;JP)
Application for certification 1987 model year light-duty vehicles, 12:37172 (R;US)
Application for certification 1987 model year light-duty vehicles - Chrysler, 12:37173 (R;US)
Application for certification 1987 model year light-duty vehicles and light-duty trucks - Ford Motor Company, 12:37174 (R;US)
Application for certification 1987 model year light-duty vehicles - General Motors, 12:37175 (R;US)
Application for certification 1987 model year light-duty vehicles - Mercedes-Benz, 12:37176 (R;US)
Application for certification 1987 model year light-duty vehicles - Nissan, 12:37177 (R;JP)
Application for certification 1987 model year light-duty vehicles - American Motors Corporation (Renault), 12:37178 (R;US)
Application for certification 1987 model year light-duty vehicles - Rolls Royce, 12:37179 (R;US)
Application for certification 1987 model year light-duty vehicles - Volkswagen, 12:37180 (R;US)
Application for certification 1987 model year light-duty vehicles, 12:37181 (R;US)
Application for certification 1987 model year light-duty vehicles - Isuzu, 12:37182 (R;US)
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)
Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Mathematical Models**
Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985, 12:37652 (R;US)

**AIR POLLUTION CONTROL**
*Use this term for items that involve the removal or management of pollutants after they are formed by a source.*
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**Data Base Management**
National Air Toxics Information Clearinghouse (NATICH) data base user's guide for data entry and editing. Interim report, 12:37641 (R;US)
**Regulations**
NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**Standards**
Review of national emission standards for mercury (final environmental impact statement), 12:37650 (R;US)

**AIR POLLUTION MONITORING**
Transition-flow reactor tube for measuring trace-gas concentrations, 12:37646 (R;US)
**Air Samplers**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**Gas Chromatography**
Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)
**Manuals**
Handbook for the review of excess emission reports. Final report, 12:37681 (R;US)
**Mass Spectroscopy**
Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)

**AIR POLLUTION MONITORS**
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
**Evaluation**
Evaluation of an L-shell X-ray based continuous air monitor for airborne plutonium for use in the waste isolation pilot plant, 12:37716 (RA;US)
**Performance Testing**
Performance of continuous air monitors based on alpha spectroscopy in a dusty environment, 12:37714 (RA;US)
**Quality Assurance**
Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)

**AIR PREHEATERS**
*See AIR HEATERS*

**AIR QUALITY**
Air-Quality Criteria for Particulate Matter and Sulfur Oxides (1982) (second addendum): assessmet of newly available health-effects information. Final report, 12:37642 (R;US)
Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report, 12:36762 (R;US)
Episodic coincident air-quality and precipitation measurements in an urban setting, 12:37664 (R;US)
Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)
**Aerosols**
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Air Filters**
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
**Air Flow**
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
**Data Analysis**
National air quality and emissions trends report, 1985, 12:37657 (R;US)

**Forecasting**
National air quality and emissions trends report, 1985, 12:37657 (R;US)
**Formaldehyde**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
**Humidity**
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Particles**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Quality Control**
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
**Radon**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
**Recommendations**
Topical report on the meeting of the Gas Research Institute Indoor Air-Quality Research Advisory Committee. Final report, February 11-13, 1986, 12:37682 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)
**Standards**
Review of the national ambient air-quality standards for particulate matter: updated assessment of scientific and technical information. Addendum to the 1982 OAQPS (Office of Air Quality Planning and Standards) staff paper. Final report, 12:37727 (R;US)
**Temperature Control**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Tobacco Smokes**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)

**AIR SAMPLERS**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**Design**
Design criteria of a virtual impactor, 12:37612 (RA;US)
**Evaluation**
Drag force and slip correction factor of aggregates measured in a Millikan apparatus, 12:37613 (RA;US)
Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier, 12:36337 (RA;US)
**Humidity**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Particles**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Radon**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)

**AIR SOURCE HEAT PUMPS**
**Energy Consumption**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)

**AIRBORNE PARTICLES**
*See PARTICULATES*

**AIRBORNE PARTICULATES**
*See PARTICULATES*

**AIRCRAFT**
**Air Pollution**
Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)
**Radar**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)

**AIRCRAFT ACCIDENTS**
*See ACCIDENTS*

**AIRCRAFT FUELS**
*See AVIATION FUELS*

**AIRPORTS**
**Air Quality**
Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)

**ALAP**
*See RADIATION PROTECTION*

**ALARM DOSEMETERS**
*See RADIATION MONITORS*

**ALARM SYSTEMS**
*See also INTRUSION DETECTION SYSTEMS*
The Livermore Security Console system, 12:36572 (R;US)
**Recommendations**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)
**Reliability**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)

**ALASKA**
**Coal Mines**
Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations, 12:36365 (R;US)
**Geothermal Resources**
Alaska geothermal bibliography, 12:36721 (R;US)
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Natural Gas Industry**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
**Petroleum Industry**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)

**ALCATOR DEVICE**
**Fuel Pellets**
Alcator pellet evaporation data and the classical flux limit parameter, 12:38339 (R;US)
**Pellet Injection**
Studies of the regime of improved particle and energy confinement following pellet injection into Alcator C, 12:38326 (R;US)
**Plasma Confinement**
Studies of the regime of improved particle and energy confinement following pellet injection into Alcator C, 12:38326 (R;US)

**ALCOHOL FUELS**
*Use for pure alcohols, alcohol-water mixtures, or alcohols with additives; for alcohol-gasoline mixtures, use GASOHOL.*
*See also ETHANOL FUELS*
**Synthesis**
The testing of catalysts for alkane activation, 12:36600 (R;US)

**ALCOHOLATES**
*See ALKOXIDES*

**ALCOHOLS**
*See also BUTANOLS*
*ETHANOL*
*GLYCOLS*
*METHANOL*
*PROPANOLS*
**Detection**
An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
**Synthesis**
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts

based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1, 12:36598 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2, 12:36599 (R;FR;In French)

**ALDEHYDO ACIDS**
*See CARBOXYLIC ACIDS*

**ALFVEN WAVES**
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)

**ALGEBRA**
**Irreducible Representations**
General Dynkin indices and their applications, 12:38213 (BA;US)

**ALKALI METAL COMPOUNDS**
*See also LITHIUM COMPOUNDS*
*POTASSIUM COMPOUNDS*
*RUBIDIUM COMPOUNDS*
*SODIUM COMPOUNDS*
**Corrosive Effects**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
**Monitoring**
Optical detection of alkali compounds, 12:36302 (RA;US)

**ALKALI METALS**
*See also POTASSIUM*
*SODIUM*
**Separation Processes**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)
**Solvent Extraction**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)

**ALKALINE EARTH METALS**
*See also BERYLLIUM*
*MAGNESIUM*
*RADIUM*
**Solvent Extraction**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)

**ALKALINE FLOODING**
*See CAUSTIC FLOODING*

**ALKANES**
*See also CYCLOALKANES*
*DECANE*
*ETHANE*
*HEPTANE*
*HEXANE*
*METHANE*
*2-METHYLBUTANE*
*2-METHYLPROPANE*
**Detection**
An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
**Dissolution**
Solubilities of higher normal alkanes in m-xylene, 12:37417 (J;US)
**Solubility**
Solubilities of higher normal alkanes in m-xylene, 12:37417 (J;US)

**ALKANOIC ACIDS**
*See CARBOXYLIC ACIDS*

**ALKENES**
*See also BUTENES*
*CYCLOALKENES*
*ETHYLENE*
**Copolymerization**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**Isomerization**
Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)

**ALKENOIC ACIDS**
*See CARBOXYLIC ACIDS*

**ALKOXIDES**
**Chemical Reaction Kinetics**
Kinetic investigations of alkoxysilane sol-gel processing, 12:37312 (BA;US)
**Computerized Simulation**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Crystal Growth**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Hydrolysis**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Molecular Structure**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Raman Spectroscopy**
Raman spectroscopic studies of titanium alkoxides using UV excitation, 12:37426 (BA;US)

**ALKYLATES**
*See ALCOHOLS*

**ALLOY-HD-8077**
*See NICKEL BASE ALLOYS*

**ALLOY-HT-9**
**Fuel Cans**
Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)

**ALLOY-IN-100**
**Microstructure**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Ultrasonic Testing**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)

**ALLOY-MA-754**
*See NICKEL BASE ALLOYS*

**ALLOY-MA-956**
*See IRON BASE ALLOYS*

**ALLOYS**
*See also ALUMINIUM ALLOYS*
*ANTIMONY ALLOYS*
*BERYLLIUM ALLOYS*
*BORON ALLOYS*
*CHROMIUM ALLOYS*
*COBALT ALLOYS*
*COPPER ALLOYS*
*GERMANIUM ALLOYS*
*GOLD ALLOYS*
*HEAT RESISTING ALLOYS*
*INDIUM ALLOYS*
*INTERMETALLIC COMPOUNDS*
*IRON ALLOYS*
*LEAD ALLOYS*
*MAGNESIUM ALLOYS*
*MANGANESE ALLOYS*
*MOLYBDENUM ALLOYS*
*NIOBIUM ALLOYS*
*POTASSIUM ALLOYS*
*RHENIUM ALLOYS*
*SELENIUM ALLOYS*
*TIN ALLOYS*
*TITANIUM ALLOYS*
*VANADIUM ALLOYS*
**Corrosion**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Deformation**
Acoustic emission produced by deformation of metals and alloys, 12:37233 (R;US)

**ALLOY-TZM**
**Powder Metallurgy**
High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)

**ALLOY-WAZ-16**
*See NICKEL BASE ALLOYS*

**ALPHA PARTICLES**
*Emitted by nuclei.*
*See also SOLAR ALPHA PARTICLES*
**Air Pollution Monitoring**
Source strength of thick, continuously deposited alpha sources, 12:37715 (RA;US)

**Physical Properties**
Source strength of thick, continuously deposited alpha sources, 12:37715 (RA;US)

**ALPHA-BEARING WASTES**
**Certification**
Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
**Radioactive Waste Disposal**
Defense Waste Management Plan for buried transuranic-contaminated waste, transuranic-contaminated soil, and difficult-to-certify transuranic waste, 12:36506 (R;US)

**ALUMINIA**
*See ALUMINIUM OXIDES*

**ALUMINIUM**
**Brittleness**
Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries, 12:37358 (J;US)
**Extrusion**
Lubication and surface finish of extruded aluminum, 12:37218 (R;US)
**Fragmentation**
A strain-rate-dependent spall mechanism transition in metals, 12:37242 (R;US)
**Mechanical Properties**
Influence of peak pressure on the substructure evolution and mechanical properties of shock-loaded 6061-T6 aluminum, 12:37221 (R;US)
**Metallurgical Effects**
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
**Microstructure**
Influence of peak pressure on the substructure evolution and mechanical properties of shock-loaded 6061-T6 aluminum, 12:37221 (R;US)
**Oxidation**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Porosity**
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
**Roughness**
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
**Ultrasonic Testing**
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)

**ALUMINIUM ALLOYS**
*See also ALLOY-IN-100*
*ALUMINIUM BASE ALLOYS*
**Fracture Properties**
Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)
**Melting Points**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)
**Optical Properties**
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**Oxidation**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)
**Performance Testing**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)
**Phase Studies**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)
**Powder Metallurgy**
High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)
**Shot Peening**
Shot peening for Ti-6Al-4V alloy compressor blades, 12:37229 (R;US)
**Sulfidation**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**Tensile Properties**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)
**Welding**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)

**ALUMINIUM ARSENIDES**
**Electric Contacts**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Electrical Properties**
GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature (T > 300°C), power electronic applications, 12:37517 (R;US)
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Interfaces**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)

**ALUMINIUM BASE ALLOYS**
**Rolling**
Use of ultrasonics for texture monitoring in aluminum alloys, 12:37264 (BA;US)
**Texture**
Use of ultrasonics for texture monitoring in aluminum alloys, 12:37264 (BA;US)
**Ultrasonic Testing**
Use of ultrasonics for texture monitoring in aluminum alloys, 12:37264 (BA;US)

**ALUMINIUM COMPOUNDS**
*See also ALUMINIUM ARSENIDES*
*ALUMINIUM OXIDES*
*ALUMINIUM SILICATES*
**Crystal Structure**
YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)

**ALUMINIUM OXIDES**
*See also SPINELS*
**Air Flow**
Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)
**Catalytic Effects**
Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)
**Chemical Preparation**
Preparation of Al/sub 2/O/sub 3/-ZrO/sub 2/ composites by adjustment of surface chemical behavior, 12:37308 (BA;US)
**Electrical Properties**
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**Ion Exchange**
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**Nondestructive Testing**
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
**Nuclear Magnetic Resonance**
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
**Porosity**
Characterization of porosity in green-state and partially densified Al/sub 2/O/sub 3/ by nuclear magnetic resonance imaging, 12:37284 (R;US)
**Thermodynamic Properties**
Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)

**ALUMINIUM SILICATES**
**Lung Clearance**
Model for deposition and long-term disposition of $^{134}$Cs-labeled fused aluminosilicate particles inhaled by guinea pigs, 12:37962 (RA;US)
**Mechanical Properties**
Advanced composite combustor structural concepts program. Final Report, 12:37343 (R;US)
**Retention**
Model for deposition and long-term disposition of $^{134}$Cs-labeled fused aluminosilicate particles inhaled by guinea pigs, 12:37962 (RA;US)
**ALUMINUM**
*See ALUMINIUM*
**ALVEOLI (PULMONARY)**
*See LUNGS*
**AMBIENT TEMPERATURE**
**Annual Variations**
Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)
**Biological Effects**
Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington, 12:37847 (J;US)
**Fluctuations**
Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington, 12:37847 (J;US)
**AMERICIUM**
**Recovery**
Recovery of transuranics from process residues, 12:36513 (R;US)
**Solvent Extraction**
Modeling americium separations in stagewise solvent extraction, 12:37437 (R;US)
**Uptake**
Interactions of plutonium and americium with bone mineral, 12:37907 (RA;US)
**AMERICIUM 241**
**Inhalation**
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
**Membrane Transport**
Preventing the translocation of inhaled $^{241}$Am in dogs using continuously infused DTPA, 12:37930 (RA;US)
**Toxicity**
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
**AMINES**
*See also ANILINE*
**Ion Exchange Chromatography**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography (Alkylamines, ethanolamine and methyldiethanolamine), 12:36474 (R;US)
**Liquid Column Chromatography**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography (Alkylamines, ethanolamine and methyldiethanolamine), 12:36474 (R;US)
**AMINO ALCOHOLS**
*See ALCOHOLS*
*AMINES*
**AMINO SUGARS**
*See AMINES*
**AMINOBENZENE**
*See ANILINE*
**AMINOGLYCIDES**
*See AMINES*
**AMMONIA**
**Chemical Analysis**
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)
**Chemical Reactions**
Dynamic behavior of reacting gas jets submerged in liquids, 12:37390 (R;US)
**Ion Exchange Chromatography**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Liquid Column Chromatography**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Scattering**
Quantum-resolved gas-surface scattering: NH/sub 3/ from Au (111), 12:38305 (BA;US)
**AMMONIUM COMPOUNDS**
**Glass**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)
**Isotope Effects**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)
**AMMUNITION**
**Hazardous Materials**
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)
**ANAEROBIC DIGESTION**
*See also BIOGAS PROCESS*
**Operation**
Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)
**Toxic Materials**
Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report, 12:36588 (R;US)
**ANALYSIS (GAS)**
*See GAS ANALYSIS*
**ANESTHETICS**
**Indoor Air Pollution**
Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York (Ethylene oxide et al.), 12:37689 (R;US)
**ANGIOGRAPHY**
*See BIOMEDICAL RADIOGRAPHY*
**ANHYDRITE**
**Uses**
Thermal oxidation of waste from wet-dry flue gas desulfurization and reuse of the final product, 12:36766 (R;SE;In Swedish, English and German)
**ANILINE**
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**ANIMAL CELLS**
*Includes human cells.*
*See also CHO CELLS*
**Oncogenic Transformations**
The multicellular nature of radiation carcinogenesis, 12:37934 (BA;US)
**ANTENNAS**
**Data Compilation**
Numerical assessment of high frequency (HF) antennas for shipboard use, 12:37466 (R;US)
**Design**
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
**Performance Testing**
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
**ANTHRACENE**
**Chemical Reaction Yield**
Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)

**Electrochemistry**
Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene, 12:37433 (J;US)
**Polymerization**
Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene, 12:37433 (J;US)

**ANTIBODIES**
**Immune Reactions**
Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)

**ANTICLINES**
**Geologic Models**
Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)

**ANTI-MISSILE SYSTEMS**
*See SPACE WEAPONS*

**ANTIMONY ALLOYS**
**De Haas-Van Alphen Effect**
The Fermi surface of CeSb, 12:37205 (R;US)
**Fermi Level**
The Fermi surface of CeSb, 12:37205 (R;US)
**Superlattices**
The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices, 12:37349 (R;US)

**ANTINEUTRINOS**
*See also ELECTRON ANTINEUTRINOS*
**Particle Production**
Bound on the number of neutrinos from $e^+e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA, 12:38128 (RA;US)

**ANTIOXIDANTS**
**Biological Effects**
Pulmonary antioxidants, 12:38004 (R;US)

**ANTIPROTON BEAMS**
**Beam Luminosity**
Luminosity of continuous beams with crossing angle, 12:37546 (BA;US)

**ANTIREFLECTION COATINGS**
**Fabrication**
Sol-gel AR films for solar applications, 12:37369 (BA;US)
**Sol-Gel Process**
Sol-gel AR films for solar applications, 12:37369 (BA;US)
**Sputtering**
Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)

**ANTI-SATELLITE SYSTEMS**
*See SPACE WEAPONS*

**ANTRIM SHALES**
*See BLACK SHALES*

**APARTMENT BUILDINGS**
**Energy Audits**
Development of a computerized multifamily audit: technical and implementation issues, 12:37037 (RA;US)
**Energy Conservation**
Conversion from central to apartment-level heating in multifamily buildings: the Asbury Park Village case study, 12:37035 (RA;US)
**Energy Consumption**
End use loads in multifamily buildings: some preliminary findings, 12:37036 (RA;US)
**Energy Efficiency**
Energy savings in 12 multifamily buildings retrofitted under a shared savings program, 12:37051 (RA;US)
Retrofit considerations in the multifamily sector, 12:37034 (RA;US)
**Retrofitting**
Retrofit considerations in the multifamily sector, 12:37034 (RA;US)
**Space Heating**
Heating cost allocation in centrally heated rental housing: energy conservation potential and standards issues, 12:37042 (RA;US)
Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings, 12:37049 (RA;US)
**Space HVAC Systems**
Measured energy savings from vent dampers in low rise apartment buildings, 12:37041 (RA;US)
**Water Heating**
Domestic hot water service in Lumley homes: a comparison of energy audit diagnosis with instrumented analysis, 12:37033 (RA;US)
Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings, 12:37049 (RA;US)

**AQUATIC ECOSYSTEMS**
*See also WETLANDS*
**Environmental Exposure Pathway**
Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Mineral Cycling**
Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary, 12:37838 (R;US)
**Productivity**
Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary, 12:37838 (R;US)

**AQUATIC ORGANISMS**
*Unspecified biota characteristic of aquatic ecosystems.*
*See also CETACEANS*
*FISHES*
**Environmental Exposure Pathway**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**Marine Surveys**
Long term effects of oil on marine benthic communities in enclosures (Norway), 12:36420 (R;NO)
**Population Dynamics**
Long term effects of oil on marine benthic communities in enclosures (Norway), 12:36420 (R;NO)
**Toxic Materials**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)

**AQUIFERS**
**Contamination**
Statistical structure and filter characteristics of tritium fluctuations in fractured basalt, 12:36541 (J;US)
**Radionuclide Migration**
An improved method for the simultaneous determination of $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$ in water, soils and sediments, 12:37848 (R;US)
**Recharge**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)

**ARAMIDS**
**Mechanical Properties**
Mechanical and thermal characterization of unidirectional aramid/epoxy. Final report, November 1985-December 1986, 12:37329 (R;US)

**ARC WELDING**
*See also GAS TUNGSTEN-ARC WELDING*
**Hazardous Materials**
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)

**ARCTIC REGIONS**
**Meteorology**
Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation, 12:37621 (R;NO;In Norwegian)
**Petroleum Industry**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**Pollution Sources**
Long range transport of air pollution to the Arctic areas seen in view of the large-scale atmospheric circulation, 12:37621 (R;NO;In Norwegian)

**ARGON**
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Ion Collisions**
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$, 12:38097 (D;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**ARIZONA**
**Paleoclimatology**
Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)
**ARMS CONTROL**
Case for strategic defense: an option for a world disarmed, 12:37595 (R;US)
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**Agreements**
Safeguarding our military space systems, 12:37190 (J;US)
**Government Policies**
Road to a more stable peace, 12:37189 (J;US)
**Historical Aspects**
Topics in arms control, 12:37187 (RA;US)
**Institutional Factors**
Arms control and future limits on nuclear weapons, 12:37193 (J;US)
Avoiding war with the Soviet Union, 12:37192 (J;US)
**Research Programs**
Laboratory and arms control, 12:37188 (J;US)
**Verification**
Arms control activities in LLNL, 12:37195 (J;US)
**ARMY PERSONNEL**
*See MILITARY PERSONNEL*
**AROMATIC ACIDS**
*See CARBOXYLIC ACIDS*
**AROMATIC COMPOUNDS**
*See AROMATICS*
**AROMATICS**
*See also ANILINE*
*BENZENE*
*PHENOLS*
*POLYCYCLIC AROMATIC HYDROCARBONS*
*QUINONES*
**Dimerization**
[Dimerization of o-quinodimethanes], 12:37399 (R;US)
**ARRAY PROCESSORS**
**Computer Architecture**
Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)
**Game Theory**
Experiments on alternatives to minimax, 12:38414 (J;US)
**Parallel Processing**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)
Experiments on alternatives to minimax, 12:38414 (J;US)
**Vector Processing**
Vector-array-processor computer equipment. Final report, 1 January-31 December 1985, 12:38052 (R;US)
**ARSENIC**
**Toxicity**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)
**ARSENIC COMPOUNDS**
**Indoor Air Pollution**
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
**ARSONIUM COMPOUNDS**
*See ARSENIC COMPOUNDS*
**ARTIFICIAL INTELLIGENCE**
**Computer Architecture**
Implementing distributed AI systems using MACE, 12:38413 (BA;US)
**Research Programs**
Implementing distributed AI systems using MACE, 12:38413 (BA;US)
**ASBESTOS**
**Air Pollution Control**
NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**Bibliographies**
Bibliography on asbestos in schools, 12:37687 (R;US)
**Indoor Air Pollution**
Bibliography on asbestos in schools, 12:37687 (R;US)
Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
**Protective Clothing**
Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)
**ASDEX TOKAMAK**
**Plasma Diagnostics**
Investigation of density fluctuations in the edge region of the divertor tokamak ASDEX, 12:38338 (R;DE;In German)
**ASHES**
*See also FLY ASH*
**Air Pollution**
Mount St. Helens: the aftermath, 12:37673 (R;US)
**Air Pollution Abatement**
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Chemical Composition**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Deposition**
Ash deposition sensor development, 12:36356 (RA;US)
Deposition effects in pressurized combustion of coal-derived fuels, 12:36357 (RA;US)
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Evaporation**
Laser-induced fluorescence detection of mineral vaporization species, 12:36358 (RA;US)
**Monitoring**
Ash deposition sensor development, 12:36356 (RA;US)
**Radioactivity**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)
**Water Pollution**
Mount St. Helens: the aftermath, 12:37673 (R;US)
**ASPENS**
**Cultivation**
Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)
**Plant Growth**
Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)
**ASPHALTS**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Hydrogenation**
Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)

**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Recycling**
Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing, 12:37139 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)

**ASTHMA**
Airway sensitivity of asthmatics to sulfur dioxide, 12:37994 (R;US)

**ASTROPHYSICS**
**Conservation Laws**
Baryon and lepton number violation in astrophysics, 12:38078 (BA;DE)

**ATF TORSATRON**
**Design**
Review of the Advanced Toroidal Facility program, 12:38368 (R;US)
**Research Programs**
Review of the Advanced Toroidal Facility program, 12:38368 (R;US)

**ATLANTIC OCEAN**
*See also NORTH SEA*
**Hydrology**
Shelf Edge Exchange Processes: Phase 1 (SEEP-1), Hydrography report, July 1983-October 1984, 12:38049 (R;US)

**ATMOSPHERIC CIRCULATION**
Simulation of aerosol dynamics: a comparative review of mathematical models, 12:37643 (R;US)

**ATMOSPHERIC EXPLOSIONS**
**Fallout**
Particle-size determination from local fallout. Master's thesis, 12:37587 (R;US)
**Simulation**
System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1, 12:37580 (R;US)

**ATMOSPHERIC PRECIPITATIONS**
*See also SNOW*
**Acidification**
RAIN project. Annual report for 1984 (Norway), 12:37622 (R;NO)
**Annual Variations**
Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)

**ATOM-ATOM COLLISIONS**
**Colliding Beams**
Low-energy collisions of excited atoms. Final report, 1 May 1984-30 April 1985, 12:38090 (R;US)
**Cross Sections**
Low-energy collisions of excited atoms. Final report, 1 May 1984-30 April 1985, 12:38090 (R;US)

**ATOMIC BEAMS**
**Control**
Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987, 12:38091 (R;US)
**Cooling**
Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987, 12:38091 (R;US)

**ATOMIC BOMBS**
*See NUCLEAR WEAPONS*

**ATOMIC ENERGY**
*See NUCLEAR ENERGY*

**ATOMIC EXPLOSIONS**
*See NUCLEAR EXPLOSIONS*

**ATOMIC FLUORESCENCE SPECTROSCOPY**
*See FLUORESCENCE SPECTROSCOPY*

**ATOMIC MODELS**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)

**ATOMIC PHYSICS**
*Use only for indexing articles of very broad coverage, such as annual reviews, text books, etc.*
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)

**ATOMIC WEAPONS**
*See NUCLEAR WEAPONS*

**ATOMS**
**Auger Effect**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)
**Inner-Shell Ionization**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)
**Ion Collisions**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)

**ATP**
**Biosynthesis**
Characteristics of the formation of enzyme-bound ATP from medium inorganic phosphate by mitochondrial $F_1$ adenosinetriphosphatase in the presence of dimethyl sulfoxide, 12:37866 (J;US)

**AURORAE**
**Infrared Spectra**
Atmospheric radiance profile codes. Technical report, 12:38085 (R;US)
Studies of infrared aurorae. Technical report, 12:38041 (R;US)

**AUSTENITIC STEELS**
*Prior to February, 1978 STEELS and AUSTENITE were used to index this concept.*
**Chemical Composition**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
**Creep**
Creep of austenitic stainless steels at room temperature, 12:37256 (TG;US)
**Radiation Effects**
Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)

**AUSTRIA**
**Forests**
Austrian survey on forest condition, 12:37790 (RA;DE;In German)

**AUTOMOBILE EFFICIENCY STANDARDS**
*See AUTOMOBILES*

**AUTOMOBILES**
*See also TAXICABS*
**Diesel Engines**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Exhaust Gases**
Passenger-car emissions in the speed range 80-120 kmph. Traffic measurements on a fleet of cars in the Pfaender Road Tunnel, 12:37183 (R;XE;In German)
**Marketing Research**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Public Opinion**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)

**AUTOMOTIVE FUELS**
**Environmental Impacts**
Environmental effects due to the use of conventional and innovating fuels for autotraction, 12:37607 (R;IT;In Italian)

**AVIATION FUELS**
**Filters**
Field evaluation of the sidestream sensors for filter/separators and clay filters, 12:36411 (R;US)
**Surfactants**
Field evaluation of the sidestream sensors for filter/separators and clay filters, 12:36411 (R;US)
**AXEROPHTOL**
*See VITAMIN A*
**AXIONS**
**Detection**
Ultralow background searches for $\beta\beta$-decay, cold dark matter and solar axions, 12:38248 (BA;DE)
**Lectures**
Strong CP problem and the visibility of invisible axions, 12:38156 (R;DE)
**Particle Production**
Recent axion searches, 12:38142 (RA;US)
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Search for short-lived axions emitted from neutron capture on protons, 12:38153 (BA;DE)

## B

**B CODES**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/ (BALDUR), 12:38344 (R;US)
**B MESONS**
**Hadronic Particle Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Leptonic Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Particle Decay**
Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look, 12:38147 (R;US)
**Particle Production**
Forward-backward asymmetry for b and c quarks, 12:38172 (RA;US)
Granlibakken meeting: b and c quark summary, 12:38187 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**Radiative Decay**
Radiative B decays with four generations, 12:38163 (R;US)
**Semileptonic Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Weak Hadronic Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**BABCOCK AND WILCOX STANDARD REACTOR**
*See BW STANDARD REACTOR*
**BACTERIA**
*See also ESCHERICHIA COLI*
*METHANOGENIC BACTERIA*
*PSEUDOMONAS*
*ZYMOMONAS MOBILIS*
**Biological Adaptation**
Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi, 12:36604 (J;US)
**Growth**
Metabolism of gallate and phloroglucinol in Eubacterium oxidoreducens via 3-hydroxyl-5-oxohexanoate, 12:38009 (J;US)
Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi, 12:36604 (J;US)
**BALLISTIC MISSILE DEFENSE**
**Computer Architecture**
Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report, 12:37186 (R;US)
**Free Electron Lasers**
Free-electron laser success explained, 12:37492 (J;US)
**Research Programs**
Laboratory and arms control, 12:37188 (J;US)
**BALLOONING INSTABILITY**
**Thermal Conductivity**
Effects of ballooning instability on tokamak confinement, 12:38329 (R;US)
**BANKS**
*See COMMERCIAL BUILDINGS*
**BARBADOS**
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**BARIUM OXIDES**
**Microstructure**
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
**Superconductivity**
Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials, 12:37287 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/, 12:37294 (R;US)
Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O$/sub x/, 12:37288 (R;US)
**BARSTOW SOLAR PILOT PLANT**
*10-MW solar central receiver pilot plant at Barstow, California.*
**Performance**
An analysis of power production performance for solar one, the 10 MWe Solar Thermal Central Receiver Pilot Plant, 12:36659 (R;US)
**Power Generation**
An analysis of power production performance for solar one, the 10 MWe Solar Thermal Central Receiver Pilot Plant, 12:36659 (R;US)
**BARYON NUMBER 2 RESONANCES**
*See DIBARYON RESONANCES*
**BATTERIES (ELECTRIC)**
*See ELECTRIC BATTERIES*
**BATTERY CHARGERS**
**Control Systems**
Aircraft battery state of charge and charge-control system. Interim report, 1 July 1985-30 June 1986, 12:36940 (R;US)
**BEAGLES**
**Respiration**
Cross-sectional study of the effects of age on pulmonary function and lung morphology of Beagle dogs, 12:37887 (RA;US)
**BEAM ANALYZERS**
*For momentum analysis of charged particle beams.*
**Design**
Cherenkov and transition radiation diagnostics for high energy free-electron lasers, 12:37483 (R;US)
**Performance Testing**
Cherenkov and transition radiation diagnostics for high energy free-electron lasers, 12:37483 (R;US)
**BEAM BUNCHING**
**Amp Beam Currents**
Calculated fraction of an incident current pulse that will be accelerated by an electron linear accelerator and comparisons with experimental data, 12:37544 (J;NL)
**BEAM MONITORS**
**Data Acquisition Systems**
Beam trajectory acquisition system for the arcs of the Stanford Linear Collider, 12:37555 (R;US)
**Design**
Beam position measurements at the SLC IP, 12:37552 (RA;US)
**BEAM TRANSPORT**
**Shielding**
Moyer model approximations for point and extended beam losses, 12:37558 (J;NL)

**BEAM-PLASMA SYSTEMS**
**Computerized Simulation**
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)
**BEAMS (STRUCTURAL)**
*See STRUCTURAL BEAMS*
**BEAUTY PARTICLES**
**Particle Production**
Experimental results on heavy flavour hadro- and photoproduction, 12:38126 (R;US)
**Weak Hadronic Decay**
Status of electroweak theory for heavy quark decays and CP violation, 12:38209 (BA;DE)
**BEAVER VALLEY-2 REACTOR**
*Shippingport, Pennsylvania, USA*
**Reactor Operation**
Technical Specifications, Beaver Valley Power Station, Unit No. 2 (Docket No. 50-412): Appendix A to License No. NPF-64, 12:36835 (R;US)
**Specifications**
Technical Specifications, Beaver Valley Power Station, Unit No. 2 (Docket No. 50-412): Appendix A to License No. NPF-64, 12:36835 (R;US)
**BEECH TREES**
**Plant Growth**
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)
**BENZENE**
**Enthalpy**
Excess molar enthalpies for the 1-butanol-benzene-cyclohexane system at 25°C, 12:37419 (J;US)
**Excitation**
Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams, 12:38096 (R;US)
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**BENZOPYRENE**
**Carcinogenesis**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
**Configuration Interaction**
Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide, 12:38010 (J;US)
**Inhalation**
Lung retention of inhaled $^{14}$C-BaP and $^{14}$C-NP when adsorbed on carbon particles, 12:37967 (RA;US)
**Lung Clearance**
Factors affecting lung retention of $^{14}$C-benzo(a)pyrene adsorbed on carbon black particles, 12:37968 (RA;US)
**Metabolism**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
Nasal metabolism of benzo[a]pyrene and dihydrosafrole in Beagle dogs and nonhuman primates, 12:37979 (RA;US)
**Retention**
Factors affecting lung retention of $^{14}$C-benzo(a)pyrene adsorbed on carbon black particles, 12:37968 (RA;US)
Lung retention of inhaled $^{14}$C-BaP and $^{14}$C-NP when adsorbed on carbon particles, 12:37967 (RA;US)
**Toxicity**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
**BERING SEA**
**Ice**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**BERL SADDLES**
*See COLUMN PACKING*
**BERYLLIA**
*See BERYLLIUM OXIDES*
**BERYLLIUM**
**Air Pollution Monitoring**
Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys, 12:37615 (RA;US)
**Centrifugation**
Beryllium particle density measurements using isopycnic density gradient centrifugation, 12:37617 (RA;US)
**Dissolution**
Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization, 12:37616 (RA;US)
**Ecological Concentration**
Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys, 12:37615 (RA;US)
**Excitation**
Kinetics of excitation and ionization of Be I in tokamak devices, 12:38354 (R;DE)
**Ionization**
Kinetics of excitation and ionization of Be I in tokamak devices, 12:38354 (R;DE)
**Particle Size**
Beryllium particle density measurements using isopycnic density gradient centrifugation, 12:37617 (RA;US)
Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys, 12:37615 (RA;US)
Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization, 12:37616 (RA;US)
**Particulates**
Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
**Tissue Distribution**
Toxicokinetics of beryllium following acute inhalation of BeO by beagle dogs: a status report, 12:37965 (RA;US)
**Toxicity**
Cytotoxicity of beryllium compounds to cultured canine alveolar macrophages, 12:37972 (RA;US)
Lung cellular response and lymphocyte blastogenesis, 12:37973 (RA;US)
Toxicokinetics of beryllium following acute inhalation of BeO by beagle dogs: a status report, 12:37965 (RA;US)
**BERYLLIUM 9**
**Hypernuclei**
Electromagnetic transitions in hypernuclei, 12:38242 (BA;DE)
**BERYLLIUM 9 TARGET**
**Deuteron Reactions**
Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range, 12:38233 (R;US)
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Proton Reactions**
Measurement of the ratio of $\Sigma 0$ to $\Lambda^0$ inclusive production from 28.5-GeV/c protons on beryllium, 12:38151 (J;US)
**BERYLLIUM ALLOYS**
**Dissolution**
Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization, 12:37616 (RA;US)
**Particle Size**
Characterization of aerosols produced during sawing and milling of beryllium metal and beryllium alloys, 12:37615 (RA;US)
Generation of aerosols of beryllium metal and beryllium oxide by laser vaporization, 12:37616 (RA;US)
**Specific Heat**
Specific heat of (U/sub 0.97/Th/sub 0.03/)Be$_{13}$ under pressure, 12:37228 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)

**BERYLLIUM MODERATORS**
*See BERYLLIUM*
**BERYLLIUM OXIDES**
**Dissolution**
In vitro dissolution studies of beryllium aerosols, 12:37403 (RA;US)
Relation of beryllium oxide properties to dissolution in vitro, 12:37404 (RA;US)
**Physical Properties**
Relation of beryllium oxide properties to dissolution in vitro, 12:37404 (RA;US)
**BETA BEAMS (ELECTRONS)**
*See ELECTRON BEAMS*
**BETA DECAY**
*For neutron and nuclear decay.*
*See also BETA-MINUS DECAY*
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
**BETA PARTICLES**
*Emitted by nuclei.*
**Inhalation**
Annual report references to dog longevity studies in which all dogs have died, 12:37909 (RA;US)
**Toxicity**
Annual report references to dog longevity studies in which all dogs have died, 12:37909 (RA;US)
**BETA SPECTROMETERS**
**Design**
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
**Sensitivity**
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
**BETA SPECTROSCOPY**
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
**BETA-MINUS DECAY**
*See also DOUBLE BETA DECAY*
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
**BICARBONATES**
*See ACID CARBONATES*
**BINARY ALLOY SYSTEMS**
**Molecular Structure**
Configurational energies in terms of effective cluster interactions in binary substitutional alloys: Connection between the Embedded Cluster Method and the Generalized Perturbation Method, 12:37245 (R;US)
**BINARY MIXTURES**
**Solvent Properties**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)
**BINARY-FLUID SYSTEMS**
**Working Fluids**
Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report, 12:36725 (R;US)
**BINDERS**
**Comparative Evaluations**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)
**Cost**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)
**BIOASSAY**
**Manuals**
Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements, 12:37877 (R;US)
**Training**
Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements, 12:37877 (R;US)
**BIOGAS**
*See METHANE*
**BIOGAS PROCESS**
Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation), 12:36590 (R;US)
**Economic Analysis**
Survey of existing methods of biogas scrubbing and utilisation, 12:36587 (R;GB)
**BIOLOGICAL REACTORS**
*See BIOREACTORS*
**BIOLOGICAL TESTING**
*See BIOASSAY*
**BIOMASS**
**Gasification**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Liquefaction**
Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)
**Pyrolysis**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Short Rotation Cultivation**
Biomass production of problematic sites by generatively and vegetatively propagated high-yield-progenies of fast growing tree species. Final report, 12:36621 (R;DE;In German)
**BIOMASS PLANTATIONS**
**Economic Analysis**
Fuels from agricultural crops. Production estimates, cost of raw products and value of by-products, 12:36638 (R;SE;In Swedish)
**Harvesting**
Chipping, transport and firing of energy forest wood. Practical tests during the winter of 1985/1986, 12:36639 (R;SE;In Swedish)
**Harvesting Equipment**
Short-rotation harvester/chipper, 12:36633 (R;XE)
**Plant Growth**
Quality and quantity of latex which can be produced from natural vegetation in Greece, 12:36630 (R;FR)
**BIOMEDICAL RADIOGRAPHY**
*See also INDUSTRIAL RADIOGRAPHY.*
**Image Processing**
NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)
**Synchrotron Radiation**
NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)
**BIOREACTORS**
*Prior to March 1983 this concept was indexed to CHEMICAL REACTORS.*
**Design**
Limits to process intensity in methane (biogas) generator systems, 12:36586 (R;GB)
**Performance**
Limits to process intensity in methane (biogas) generator systems, 12:36586 (R;GB)
**Performance Testing**
Algal biomass from farm waste. A pilot plant study, 12:36628 (R;GB)
Report on anaerobic digestion of dairy cattle wastes to October 1981, 12:36585 (R;GB)
**BIOTECHNOLOGY**
*The application of principles of technology or engineering to the life sciences.*
**Human Factors Engineering**
Air Force Technical Objectives Document, Fiscal Year 1988. Annual report, January 1986-January 1987, 12:37185 (R;US)
**BIPYRIDINES**
**Electric Impedance**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)

**Reflectivity**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)

**BIRCHES**
**Mortality**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Plant Growth**
Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)
Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)
**Population Dynamics**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)

**BITUMINOUS COAL**
**Chemical Composition**
In situ real-time analysis of particulates, 12:36355 (RA;US)
**Combustion Kinetics**
In situ real-time analysis of particulates, 12:36355 (RA;US)
**Combustion Products**
Effect of pore structure on the char-steam reaction, 12:36287 (B;US)
**Particle Size**
In situ real-time analysis of particulates, 12:36355 (RA;US)

**BLACK SHALES**
**Mathematical Models**
Recovery efficiency aspects of horizontal well drilling in Devonian shale, 12:36434 (BA;US)

**BLADES (TURBINES)**
*See TURBINE BLADES*

**BLENDERS**
*See MIXERS*

**BLOOD CHEMISTRY**
Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)

**BODY BURDEN**
**Radiometric Analysis**
Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements, 12:37877 (R;US)

**BOILER FUEL**
*See BOILER FUELS*

**BOILER FUELS**
**Meetings**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)
**Quality Control**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)

**BOILERS**
*See also FLUIDIZED BED BOILERS*
*REFUSE-FUELED BOILERS*
**Air Pollution Abatement**
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Air Pollution Control**
Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)
**Combustion Products**
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
**Flue Gas**
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Fly Ash**
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
**Fouling**
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Heat Recovery**
Low temperature heat recovery, 12:37104 (R;GB)

**BOILING WATER COOLED AND MODERATED REACTO**
*See BWR TYPE REACTORS*

**BONE DISEASES**
*See SKELETAL DISEASES*

**BONES**
*See SKELETON*

**BONNEVILLE POWER ADMINISTRATION**
**Rate Structure**
1986 variable industrial power rate: Executive summary of Administrator's Record of Decision, 12:36994 (R;US)

**BOOSTERS (PARTICLE)**
*See PARTICLE BOOSTERS*

**BORATES**
*Specific compounds, except those of significance to energy reserach and development, should be indexed by coordination of a descriptor of the form (CATION) COMPOUNDS and the above anion descriptor.*
**Chemical Preparation**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)
**Gelation**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)
**Structural Chemical Analysis**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)

**BOREHOLES**
**Deformation**
Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff (NNWSI), 12:36538 (R;US)
**Simulation**
Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986 (In a coal deposit), 12:36312 (R;US)
**Stresses**
Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff (NNWSI), 12:36538 (R;US)

**BORON**
**Corrosive Effects**
Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel, 12:37261 (J;US)
**Electronic Structure**
Electronic structure of boron and boron rich borides, 12:37239 (R;US)
**Segregation**
Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel, 12:37261 (J;US)

**BORON ALLOYS**
**Kondo Effect**
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
**Magnetic Properties**
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**Microstructure**
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**BORON CARBIDES**
**Thermal Conductivity**
Microscopic origin of the composition-dependent change of the thermal conductivity in boron carbides, 12:37304 (R;US)
**BORON PHOSPHIDES**
**Electronic Structure**
Electronic structure of boron and boron rich borides, 12:37239 (R;US)
**BOROSILICATE GLASS**
**Chemical Bonds**
Solution chemistry of silicate and borate materials, 12:37323 (BA;US)
**Dissolution**
Solution chemistry of silicate and borate materials, 12:37323 (BA;US)
**Sol-Gel Process**
Solution chemistry of silicate and borate materials, 12:37323 (BA;US)
**Structural Chemical Analysis**
Solution chemistry of silicate and borate materials, 12:37323 (BA;US)
**BOROSILICATES**
*See BOROSILICATE GLASS*
**BOTTOM MESONS**
*See B MESONS*
**BOTTOM PARTICLES**
*See BEAUTY PARTICLES*
**BPA**
*See BONNEVILLE POWER ADMINISTRATION*
**BRACKISH WATER ECOSYSTEMS**
*See AQUATIC ECOSYSTEMS*
**BRAKES**
**Maintenance Facilities**
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
**BRAZIL**
**Forestry**
Monitoring the modifications in the forest ecosystem of the Brazilian Amazon region through remote sensing techniques, 12:37938 (RA;DE)
**BREASTS**
*See MAMMARY GLANDS*
**BREMSSTRAHLUNG (MAGNETIC)**
*See SYNCHROTRON RADIATION*
**BRINES**
**Chemical Composition**
Trace rare earth element analysis in briny groundwaters, 12:38045 (R;US)
**Migration**
Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
**Phase Diagrams**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**Radionuclide Migration**
Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36496 (R;US)
**BROMIDES**
**Configuration Interaction**
Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide, 12:38010 (J;US)
**BRONCHOGENIC CARCINOMA**
*See CARCINOMAS*
*RESPIRATORY SYSTEM DISEASES*
**BROOKHAVEN AGS**
**Experiment Planning**
High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
**Operation**
High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
**BROOKHAVEN INTERSECTING STORAGE ACCELERAT**
*See ISABELLE STORAGE RINGS*
**BROWNS FERRY-1 REACTOR**
*Decatur, Alabama, USA*
**ATWS**
Severe Accident Sequence Analysis Program: Anticipated transient without scram simulations for Browns Ferry Nuclear Plant Unit 1, 12:36919 (R;US)
**Reactor Safety**
Severe Accident Sequence Analysis Program: Anticipated transient without scram simulations for Browns Ferry Nuclear Plant Unit 1, 12:36919 (R;US)
**BUCKLING (STRUCTURAL)**
*See DEFORMATION*
**BUILDING MATERIALS**
*See also CONCRETES*
**Research Programs**
Testing thermal insulations with a thin-heater apparatus, 12:37023 (R;US)
**Testing**
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)
**Volatile Matter**
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)
**BUILDINGS**
*See also COMMERCIAL BUILDINGS*
*CONTAINMENT BUILDINGS*
*DOUBLE ENVELOPE BUILDINGS*
*FEDERAL BUILDINGS*
*GREENHOUSES*
*HOSPITALS*
*OFFICE BUILDINGS*
*PREFABRICATED BUILDINGS*
*PUBLIC BUILDINGS*
*RESIDENTIAL BUILDINGS*
*SCHOOL BUILDINGS*
**Air Conditioners**
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Air Conditioning**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Air Heaters**
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Air Infiltration**
Improving infiltration control techniques in low income weatherization, 12:37056 (RA;US)
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)
**Air Quality**
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)

**Asbestos**
NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**Closed-Cycle Cooling Systems**
Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986, 12:37079 (R;US)
**Computerized Simulation**
Night ventilation strategies in dry climates, 12:36694 (BA;US)
**Cooling Load**
Night ventilation strategies in dry climates, 12:36694 (BA;US)
**Decommissioning**
Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)
**Decontamination**
Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)
Use of risk assessment methods in the certification of decontamination buildings, 12:37620 (RA;US)
**Demonstration Programs**
[1984 Alliance to Save Energy/DOE Cooperative Agreement], 12:37028 (R;US)
**District Cooling**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)
**District Heating**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)
**Energy Consumption**
Calculated and measured energy consumption for low energy houses, 12:37038 (RA;US)
**Energy Efficiency**
[1984 Alliance to Save Energy/DOE Cooperative Agreement], 12:37028 (R;US)
Applications of thermography, 12:37050 (RA;US)
Cross-comparisons of new energy-efficient houses, 12:37031 (RA;US)
Measured performance of superinsulated homes in Montana: second report, 12:37052 (RA;US)
Membranes improve insulation efficiency, 12:37030 (RA;US)
Minnesota energy efficient house research project, 12:37047 (RA;US)
Results of construction quality inspections of 25 low-energy Minnesota homes, 12:37048 (RA;US)
Thermabilt energy efficient residential construction research, demonstration and technology transfer, 12:37059 (RA;US)
Umea energy savings blocks quality controlled programs save up to 40% energy in houses built in the 70's, 12:37043 (RA;US)
**Energy Management**
Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)
**Environmental Engineering**
Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)
**Foundations**
Generalized method to estimate the thermal performance of earth contact walls and floors, 12:37053 (RA;US)
**Heat Losses**
Overview of the heat loss study for the Hood River Conservation Project, 12:37060 (RA;US)
**Indoor Air Pollution**
Bibliography on indoor radon pollution, 12:37721 (R;US)
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
**Leak Detectors**
Improving infiltration control techniques in low income weatherization, 12:37056 (RA;US)
**Natural Convection**
Flow coefficients for interzonal natural convection for various apertures, 12:36691 (BA;US)
**Passive Solar Cooling Systems**
Night ventilation strategies in dry climates, 12:36694 (BA;US)
**Passive Solar Heating Systems**
Flow coefficients for interzonal natural convection for various apertures, 12:36691 (BA;US)
Interzonal mixed convection heat transfer in a passive solar building, 12:36695 (BA;US)
Metal-glass facades with an integrated heating/cooling/ventilation system, 12:37076 (R;DE;In German)
**Quality Control**
Results of construction quality inspections of 25 low-energy Minnesota homes, 12:37048 (RA;US)
**Retrofitting**
[1984 Alliance to Save Energy/DOE Cooperative Agreement], 12:37028 (R;US)
**Solar Air Conditioning**
Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**Solar Equipment**
Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**Solar Space Heating**
Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**Space Heating**
Reducing temperature imbalance in single-pipe steam buildings, 12:37044 (RA;US)
**Thermal Analysis**
Proposal of a simplified model for building thermal behaviour simulation, 12:37069 (R;FR;In French)
**Thermal Comfort**
Keeping warm: findings from the Kansas City warm room retrofit project, 12:37058 (RA;US)
**Thermal Insulation**
Membranes improve insulation efficiency, 12:37030 (RA;US)
**Thermodynamics**
Interzonal mixed convection heat transfer in a passive solar building, 12:36695 (BA;US)
**Ventilation Systems**
Indoor air quality and ventilation requirements, 12:37084 (R;FI;In Finnish)
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Weatherization**
Fuel savings analysis: house doctoring and storm windows, 12:37046 (RA;US)
State of Minnesota high level weatherization project, 12:37057 (RA;US)

**BUILDINGS (CONTAINMENT)**
*See CONTAINMENT BUILDINGS*

**BUNCHING (BEAM)**
*See BEAM BUNCHING*

**BUNKER OILS**
*See RESIDUAL FUELS*

**BURNERS**
**Air Pollution Abatement**
Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)
**Combustion Kinetics**
Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)
**Design**
Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987, 12:36361 (R;US)

**BUTANOLS**
**Enthalpy**
Excess molar enthalpies for the 1-butanol-benzene-cyclohexane system at 25°C, 12:37419 (J;US)
**Phase Diagrams**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**BUTENES**
**Dehydrogenation**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Oxidation**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**BUTYL ALCOHOLS**
*See BUTANOLS*
**BUTYLENES**
*See BUTENES*
**BUTYRIC ALCOHOLS**
*See BUTANOLS*
**BW STANDARD REACTOR**
*Prior to 1975, PWR/241 Type Reactors was used.*
**Heat Transfer**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**Hydraulics**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**Loss of Coolant**
Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system, 12:36846 (RA;US)
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)
**Pipes**
Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend, 12:36854 (RA;US)
**Reactor Safety**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend, 12:36854 (RA;US)
Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system, 12:36846 (RA;US)
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)
**Test Facilities**
Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
**BWR TYPE REACTORS**
*See also BROWNS FERRY-1 REACTOR*
*HATCH-2 REACTOR*
*HOPE CREEK-2 REACTOR*
*LAGUNA VERDE-1 REACTOR*
*LAGUNA VERDE-2 REACTOR*
**Containment Systems**
Containment and piping research, 12:36890 (RA;US)
Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
**Design**
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)
**ECCS**
Experience with the revised Appendix K, 12:36839 (RA;US)
Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
Revision of the ECCS rule, 12:36837 (RA;US)
**Engineered Safety Systems**
Preliminary conceptual design study for a small LWR: Final report, 12:36772 (R;US)
**Lifetime**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
**Loss of Coolant**
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
**Mixed Oxide Fuels**
Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
**Nuclear Data Collections**
Nuclear plant data bank, 12:36870 (RA;US)
**Outages**
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**Pipes**
Containment and piping research, 12:36890 (RA;US)
**Reactor Accidents**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
Influence of moisture on the behavior of aerosols, 12:36898 (RA;US)
Integrated ex-vessel source term analysis with the CONTAIN 1.1 computer code, 12:36901 (RA;US)
LWR aerosol containment experiments (LACE) program summary and preliminary observations, 12:36899 (RA;US)
MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
QUASAR uncertainty study, 12:36905 (RA;US)
Recent results in hydrogen research, 12:36915 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)
Thermal-hydraulic studies on molten core-concrete interactions, 12:36903 (RA;US)
**Reactor Components**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
**Reactor Control Systems**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
**Reactor Core Disruption**
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)
**Reactor Instrumentation**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Reactor Kinetics**
Three-D neutronics model implementation into TRAC-BD1, 12:36877 (RA;US)
**Reactor Noise**
Comments on remarks on the inadequacy of one-group heterogeneous theories for the interpretation of incore neutron noise in BWRs, 12:36776 (J;GB)
**Reactor Operation**
Licensee event report (LER) compilation: For month of April 1987, 12:36797 (R;US)
Licensee event report (LER) compilation for month of February 1987, 12:36796 (R;US)
Licensee event report (LER) compilation for month of January 1987, 12:36795 (R;US)
Use of probabilistic systems analysis for enhancing plant operational safety and productivity, 12:36891 (RA;US)
**Reactor Operators**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
Emergency response training with the BNL plant analyzer, 12:36811 (R;US)

**Reactor Safety**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
BWR plant analyzer development at BNL, 12:36869 (RA;US)
Code uncertainty quantification, 12:36879 (RA;US)
Containment and piping research, 12:36890 (RA;US)
CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
Dryout front modeling for rod bundles, 12:36852 (RA;US)
Experience with the revised Appendix K, 12:36839 (RA;US)
Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
Nuclear plant data bank, 12:36870 (RA;US)
Nuclear safety—forward on technology and backward on perception, 12:36889 (RA;US)
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
Revision of the ECCS rule, 12:36837 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
Status of integral facilities and future plans for integral testing, 12:36840 (RA;US)
Status of the TRAC-BWR Program, 12:36865 (RA;US)
STCP validation, 12:36909 (RA;US)
Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)
Three-D neutronics model implementation into TRAC-BD1, 12:36877 (RA;US)
TRAC code development status and plans, 12:36867 (RA;US)
TRAC development at General Electric, 12:36876 (RA;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
Validation of TRAC-PD2 against experiment LP-02-6 of the OECD-LOFT series, 12:36878 (RA;US)
**Reactor Shutdown**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**Reactor Simulators**
Emergency response training with the BNL plant analyzer, 12:36811 (R;US)
**Reliability**
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
**RHR Systems**
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**Risk Assessment**
Use of probabilistic systems analysis for enhancing plant operational safety and productivity, 12:36891 (RA;US)
**Rod Bundles**
Dryout front modeling for rod bundles, 12:36852 (RA;US)
**Service Life**
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
**Source Terms**
STCP validation, 12:36909 (RA;US)
**Steam Separators**
Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)
**Systems Analysis**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**Temperature Measurement**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Transients**
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
BWR plant analyzer development at BNL, 12:36869 (RA;US)
Code uncertainty quantification, 12:36879 (RA;US)
CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
Three-D neutronics model implementation into TRAC-BD1, 12:36877 (RA;US)
TRAC development at General Electric, 12:36876 (RA;US)
Validation of TRAC-PD2 against experiment LP-02-6 of the OECD-LOFT series, 12:36878 (RA;US)
**BY-PRODUCTS**
**Environmental Impacts**
Demilitarization of conventional ordnance: Priorities for database assessments of environmental contaminants, 12:37584 (R;US)

## C

**C-2260 RESONANCES**
*See LAMBDA C PLUS*
**CABLES (ELECTRIC)**
*See ELECTRIC CABLES*
**CADMIUM**
**Biological Indicators**
Effects of environmental factors (food, heavy metals) on teleostean hepatocytes, 12:37986 (R;DE;In German)
**Industrial Medicine**
Summarization of recent literature pertaining to an occupational health standard for cadmium. Final report, 12:37991 (R;US)
**Toxicity**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)
Summarization of recent literature pertaining to an occupational health standard for cadmium. Final report, 12:37991 (R;US)
**Uptake**
Uptake and distribution of heavy metals in annelidae, with particular regard to limnic tubificides (oligochaeta), 12:37987 (R;DE;In German)
**Water Pollution**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**CADMIUM COMPOUNDS**
*See also CADMIUM TELLURIDES*
**Health Hazards**
Cadmium technical support document, 12:37995 (R;US)
**Toxicity**
Cadmium technical support document, 12:37995 (R;US)
**CADMIUM TELLURIDES**
**Crystal Growth**
Computational analyses of crystal growth. Final report, 12:37345 (R;US)
**CALCIUM 40 TARGET**
**Electron Reactions**
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)

Studies of hypernuclei by associated production, 12:38237 (R;US)
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)
**CALCIUM 45**
**Membrane Transport**
Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)
**CALCIUM CHLORIDES**
**Density**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Free Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Specific Heat**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**CALCIUM OXIDES**
**Evaporation**
Laser-induced fluorescence detection of mineral vaporization species, 12:36358 (RA;US)
**CALIFORNIA**
*See also LOS ANGELES*
**Air Pollution**
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
**Wind**
Improving the performance of mass-consistent numerical models using optimization techniques, 12:36736 (J;US)
**CALIFORNIUM 252**
**Fission Fragments**
On ion induced hard errors in dielectric structures, 12:37516 (R;US)
**CALMODULIN**
**Biochemical Reaction Kinetics**
Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)
**CALORIMETERS**
**Fires**
Thermal measurements in large pool fires, 12:37462 (R;US)
**Heat Transfer**
Heat transfer to large objects in large pool fires, 12:37464 (R;US)
**Performance**
Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics, 12:37573 (J;NL)
**CALORIMETERS (PARTICLE)**
*See SHOWER COUNTERS*
**CAM**
*See COMPUTER-AIDED MANUFACTURING*
**CAMAC SYSTEM**
*Computer Application to Measurement And Control.*
**Equipment Interfaces**
VMS software for the Jorway-411 interface, 12:38408 (R;US)
**CAMPHOR**
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**CANADA**
*See also QUEBEC*
**Fossil-Fuel Power Plants**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)
**Great Lakes**
Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report, 12:37845 (R;US)
**CANCER**
*See NEOPLASMS*
**CANINES**
*See DOGS*
**CANISTERS**
*See CONTAINERS*
**CAPACITIVE ENERGY STORAGE EQUIPMENT**
Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986, 12:36937 (R;US)
**CAPACITORS**
**Energy Storage**
Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986, 12:36937 (R;US)
**Failure Mode Analysis**
Materials performance analysis of perfluorocarbon liquid/plastic film capacitors, 12:37368 (BA;US)
**Microstructure**
Capacitive energy storage at cryogenic temperatures. Annual report, 1 January-31 December 1986, 12:36937 (R;US)
**Performance Testing**
On ion induced hard errors in dielectric structures, 12:37516 (R;US)
**CAPACITY**
**Optimization**
Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)
**CARBINOL**
*See METHANOL*
**CARBON**
*See also ACTIVATED CARBON*
**Electronic Structure**
Structure, stability, and fragmentation of small carbon clusters, 12:37409 (J;US)
**Energy-Level Density**
Density-of-states calculations within the recursion method, 12:38303 (J;US)
**Gasification**
Kinetics of chemisorption and gasification reactions of carbon for evaluation of the role of electron-transfer processes. Annual report, January-December 1986, 12:36460 (R;US)
**Heating**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**Mechanical Tests**
Mechanical testing of carbon foam, 12:37341 (R;US)
**Metabolism**
Carbon and carbon metabolism in the environment, 12:37905 (R;DE)
**Molecular Structure**
Structure, stability, and fragmentation of small carbon clusters, 12:37409 (J;US)
**Sorptive Properties**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**CARBON 12**
**Isotope Ratio**
Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
**M1-Transitions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**M2-Transitions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**CARBON 12 REACTIONS**
**Nuclear Fragments**
Probing the direct step of relativistic heavy ion fragmentation: ($^{12}C$, $^{11}B+p$) at 2.1 GeV/nucleon with C and $CH_3$ targets, 12:38239 (R;US)
**CARBON 12 TARGET**
**Carbon 12 Reactions**
Probing the direct step of relativistic heavy ion fragmentation: ($^{12}C$, $^{11}B+p$) at 2.1 GeV/nucleon with C and $CH_3$ targets, 12:38239 (R;US)

**Electron Reactions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Oxygen 16 Reactions**
An optical model analysis of $^{16}O + {}^{12}C$ elastic scattering at E/A = 94 MeV, 12:38266 (R;US)
**Pion Plus Reactions**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
Studies of hypernuclei by associated production, 12:38237 (R;US)

**CARBON 13**
**E1-Transitions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**Isotope Ratio**
Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
**M1-Transitions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**M4-Transitions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)

**CARBON 13 TARGET**
**Electron Reactions**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**CARBON CYCLE**
**Global Aspects**
Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide, 12:37603 (RA;US)

**CARBON DIOXIDE**
**Air-Biosphere Interactions**
Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide, 12:37603 (RA;US)
**Biological Effects**
Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide, 12:37953 (RA;US)
Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions, 12:37952 (RA;US)
**Biological Indicators**
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
**Ecological Concentration**
Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)
Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide, 12:37953 (RA;US)
**Environmental Transport**
Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide, 12:37603 (RA;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Gelation**
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
**Infrared Spectra**
Medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide at 800k, 12:38018 (R;US)
Studies of infrared aurorae. Technical report, 12:38041 (R;US)
**Rheology**
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)
**Toxicity**
Potential physiological and ecological effects of increasing $CO_2$ on forests, 12:37948 (RA;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)

**CARBON DIOXIDE LASERS**
**Energy Transfer**
Kinetic model for the vibrational energy exchange in flowing molecular gas mixtures. Ph.D. Thesis, 12:37491 (TG;US)

**CARBON ISOTOPES**
*See also CARBON 12*
*CARBON 13*
**Proton Reactions**
(p-arrow-right,n) reaction on carbon isotopes at E/sub p/ = 160 MeV, 12:38241 (J;US)

**CARBON MONOXIDE**
**Copolymerization**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Hydrogenation**
Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures, 12:36603 (R;US)
Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
**Mathematical Models**
User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)

**Methanation**
Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Monitoring**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)

**CARBON OXIDE SULFIDE**
*See CARBON OXYSULFIDE*

**CARBON OXYCHLORIDE**
*See PHOSGENE*

**CARBON OXYSULFIDE**
**Monitoring**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)

**CARBON STEELS**
*See also STEEL-ASTM-A106*
**Protective Coatings**
Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)

**CARBONYL CHLORIDE**
*See PHOSGENE*

**CARBONYL SULFIDE**
*See CARBON OXYSULFIDE*

**CARBONYLS**
*Only for compounds of metals with carbonyl radicals.*
**Catalytic Effects**
Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)

**CARBOXYLIC ACIDS**
*See also MONOCARBOXYLIC ACIDS*
**Alkylation**
Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)

**CARCINOGENESIS**
**Time Dependence**
The multicellular nature of radiation carcinogenesis, 12:37934 (BA;US)

**CARCINOGENS**
**Bioassay**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Chemical Analysis**
Surface-enhanced Raman analysis of Benzo[A]Pyrene-DNA adducts on silver-coated cellulose substrates, 12:37386 (J;US)
**Risk Assessment**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)

**CARCINOMAS**
**Radioinduction**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}Ce$. XII, 12:37916 (RA;US)
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)

**CAROTENOIDS**
**Research Programs**
Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987, 12:37435 (R;US)

**CARS SPECTROSCOPY**
*See RAMAN SPECTROSCOPY*

**CASKS**
*See also SPENT FUEL CASKS*
**Fires**
Thermal measurements in large pool fires, 12:37462 (R;US)
**Heat Transfer**
An experimental and analytical evaluation of a Type B radioactive transport container, 12:37460 (R;US)
Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure, 12:36492 (R;US)
**Testing**
Thermal measurements in large pool fires, 12:37462 (R;US)

**CASTE (INSECTS)**
*See INSECTS*

**CATALYST SUPPORTS**
**Research Programs**
Properties of lanthanide oxides as supports for transition metal catalysts: Progress report for the period May 1, 1986 to April 30, 1987, 12:37333 (R;US)

**CATALYSTS**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Catalyst Supports**
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
**Chemical Composition**
Activation and promotion studies in a mixed slurry reactor with an iron-manganese Fischer-Tropsch catalyst, 12:37412 (J;US)
**Chemical Preparation**
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987, 12:36584 (R;US)
Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)
**Comparative Evaluations**
Catalytic coprocessing: Effect of catalyst type and sequencing, 12:36281 (J;US)
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
**Deactivation**
Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
**Electron Spin Resonance**
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)
**Microstructure**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**Performance Testing**
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987, 12:36584 (R;US)
Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)

The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
The testing of catalysts for alkane activation, 12:36600 (R;US)
**Photoelectron Spectroscopy**
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)
**Poisoning**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Porosity**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**Regeneration**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**Sorptive Properties**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Specificity**
Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)
**CATHODIC PROTECTION**
Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
**CAUSTIC FLOODING**
**Rock-Fluid Interactions**
Enhanced oil recovery through in-situ generated surfactants augmented by chemical injection: First annual report for the period October 1985-September 1986, 12:36380 (R;US)
**Simulators**
Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)
**CAVING MINING**
**Technology Assessment**
Thick-seam mining in the Western United States--geological considerations. Information Circular/1986, 12:36343 (R;US)
**CAVITIES**
*See also BOREHOLES*
*SALT CAVERNS*
**Deformation**
The Cliper Data Acquisition System, 12:37594 (R;US)
**CAVITY RECEIVERS**
**Comparative Evaluations**
An external molten salt solar central receiver test, 12:36665 (BA;US)
**Radiant Heat Transfer**
Gas-particle flow within a high temperature solar cavity receiver including radiation heat transfer, 12:36708 (J;US)
**Testing**
An external molten salt solar central receiver test, 12:36665 (BA;US)
**Two-Phase Flow**
Gas-particle flow within a high temperature solar cavity receiver including radiation heat transfer, 12:36708 (J;US)
**CBA (BROOKHAVEN COLLIDING BEAM ACCELERATO**
*See ISABELLE STORAGE RINGS*
**CEBAF ACCELERATOR**
The CEBAF [Continuous Electron Beam Accelerator Facility] project, 12:37529 (R;US)
The CEBAF [Continuous Electron Beam Accelerator Facility] superconducting accelerator: An overview, 12:37530 (R;US)
**Beam Optics**
Optics of beam recirculation in the CEBAF [Continuous Electron Beam Accelerator Facility] cw linac, 12:37542 (R;US)
**Computerized Control Systems**
The CEBAF [Continuous Electron Beam Accelerator Facility] control system architecture, 12:37531 (R;US)
**Cryostats**
The CEBAF [Continuous Electron Beam Accelerator Facility] cavity cryostat, 12:37548 (R;US)
**Design**
The Continuous Electron Beam Accelerator Facility, 12:37532 (R;US)
**Experiment Planning**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
Electromagnetic studies in nuclei, 12:38234 (R;US)
Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
**Instability**
Multipass beam breakup in the CEBAF [Continuous Electron Beam Accelerator Facility] superconducting linac, 12:37541 (R;US)
**Research Programs**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
**Waveguides**
An optimized input waveguide for the CEBAF [Continuous Electron Beam Accelerator Facility] Superconducting Linac Cavity, 12:37549 (R;US)
**CEDARS**
**Plant Growth**
Potential in using elemental concentrations in radial increments of old growth eastern red cedar to examine the chemical history of the environment, 12:38035 (RA;US)
**CELL GROWTH (ANIMAL)**
*See ANIMAL CELLS*
**CELLS (ANIMAL)**
*See ANIMAL CELLS*
**CELLS (BACTERIAL)**
*See BACTERIA*
**CELLS (ELECTROLYTIC)**
*See ELECTROLYTIC CELLS*
**CELLULASE**
*Code number 3.2.1.4.*
**DNA-Cloning**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**CELLULASES**
*See CELLULASE*
**CELLULOSE**
**Acid Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**Enzymatic Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**CENTRAL RECEIVER POWER PLANTS**
*See TOWER FOCUS POWER PLANTS*
**CENTRAL RECEIVERS**
**Comparative Evaluations**
An external molten salt solar central receiver test, 12:36665 (BA;US)
**Computerized Simulation**
SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
Value/cost optimization of solar central receiver electric power plants, 12:36662 (BA;US)
**Cost Benefit Analysis**
Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
Value/cost optimization of solar central receiver electric power plants, 12:36662 (BA;US)
**Cost Estimation**
Cost drivers for solar thermal central receiver power plants, 12:36661 (BA;US)
**Design**
Solar thermal central receiver power - A viable option for the 1990's, 12:36674 (BA;US)
Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system, 12:36668 (BA;US)

**Economics**
SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
**Energy Accounting**
Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
**Feasibility Studies**
The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system, 12:36668 (BA;US)
**Heat Losses**
A flux-on method for determining thermal losses from solar central receivers, 12:36663 (BA;US)
**Heat Transfer Fluids**
An external molten salt solar central receiver test, 12:36665 (BA;US)
Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system, 12:36668 (BA;US)
The Molten Salt Electric Experiment: A project overview, 12:36666 (BA;US)
**Mathematical Models**
Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
**Performance Testing**
The Molten Salt Electric Experiment: A project overview, 12:36666 (BA;US)
**Reviews**
Solar thermal central receiver power - A viable option for the 1990's, 12:36674 (BA;US)
**S Codes**
SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
Value/cost optimization of solar central receiver electric power plants, 12:36662 (BA;US)
**Solar Reflectors**
Terminal concentrators for solar central receiver applications, 12:36669 (BA;US)
**Testing**
An external molten salt solar central receiver test, 12:36665 (BA;US)
Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
**Thermal Efficiency**
Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
**Thermodynamics**
Terminal concentrators for solar central receiver applications, 12:36669 (BA;US)

**CENTRIFUGAL CONTACTORS**
*See EXTRACTION APPARATUSES*

**CENTRIFUGATION**
**Experiment Planning**
FY 86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center, 12:36231 (R;US)

**CENTRIFUGE ENRICHMENT PLANTS**
**Power Systems**
System design description for the CPDF [Centrifuge Plant Demonstration Facility] electric power system: SDD-9, 12:36479 (R;US)

**CERAMICS**
**Chemical Composition**
Precursors of titanium carbonitride, 12:37311 (BA;US)
**Chemical Preparation**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)
Precursors of titanium carbonitride, 12:37311 (BA;US)
**Materials Testing**
Testing of developmental ceramic materials in diesel engine combustion chambers, 12:37160 (R;US)
**Mechanical Properties**
Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)
Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Phase Diagrams**
Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Annual report, 1 March 1986-27 February 1987, 12:37279 (R;US)
**Phase Transformations**
Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Porosity**
Porosity and thermal shock behaviour of ceramic materials, 12:37299 (R;DE;In German)
**Protective Coatings**
Performance of ceramics in ring/cylinder applications, 12:37167 (B;US)
**Structural Chemical Analysis**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)
**Thermal Shock**
Porosity and thermal shock behaviour of ceramic materials, 12:37299 (R;DE;In German)
**Thermodynamic Properties**
Performance of ceramics in ring/cylinder applications, 12:37167 (B;US)
**Tribology**
Performance of ceramics in ring/cylinder applications, 12:37167 (B;US)
The joint effect of surface microtopography and near-surface structure on microcontact conditions: Quarterly progress report for period 31 March 1987 to 30 June 1987, 12:37295 (R;US)
**Ultrasonic Testing**
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)

**CERIUM 144**
**Inhalation**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}$Ce. XII, 12:37916 (RA;US)
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble form by Beagle dogs XIX, 12:37913 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
**Toxicity**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}$Ce. XII, 12:37916 (RA;US)
Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. II, 12:37925 (RA;US)
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble form by Beagle dogs XIX, 12:37913 (RA;US)
Toxicity of $^{144}$Ce inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)

**CERIUM ALLOYS**
**De Haas-Van Alphen Effect**
The Fermi surface of CeSb, 12:37205 (R;US)
**Fermi Level**
The Fermi surface of CeSb, 12:37205 (R;US)
**Specific Heat**
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)

CERIUM COMPOUNDS
Electric Conductivity
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
Magnetic Susceptibility
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
CERMETS
Evaluation
Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)
CERTIFICATION
Nondestructive Analysis
Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
Quality Assurance
Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
CESIUM 137
Removal
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
Toxicity
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)
CETACEANS
Baseline Ecology
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
CHARGED PARTICLES
*In addition to the specific charged particles listed below, see also the list under ELEMENTARY PARTICLES.*
*See also ALPHA PARTICLES*
*BETA PARTICLES*
*DEUTERONS*
Interactions
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
CHARGED-PARTICLE ACTIVATION
*See CHARGED PARTICLES*
CHARGED-PARTICLE TRANSPORT
Plasma Simulation
Plasma current sustained by fusion charged particles in a field reversed configuration, 12:38331 (R;US)
CHARM PARTICLES
*See also D MESONS*
*F MESONS*
*LAMBDA C PLUS*
Particle Production
Experimental results on heavy flavour hadro- and photo-production, 12:38126 (R;US)
Photoproduction
Study of charm production mechanisms at the Fermilab Tagged Photon Spectrometer: γBe yields D anti D x and γA yields psi x, 12:38125 (R;US)
Weak Hadronic Decay
Status of electroweak theory for heavy quark decays and CP violation, 12:38209 (BA;DE)
CHARS
Chemical Reaction Kinetics
Effect of pore structure on the char-steam reaction, 12:36287 (B;US)
Recovery
STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)
Structural Chemical Analysis
Effect of pore structure on the char-steam reaction, 12:36287 (B;US)
CHELATING AGENTS
*See also DTPA*
Chelating extractants of improved selectivity: Final report, 12:37373 (R;US)
CHEMICAL EFFLUENTS
Waste Management
Environmental information document: Y Area, 12:36549 (R;US)
CHEMICAL ENGINEERING
Research Programs
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
CHEMICAL EXPLOSIVES
*See also NITROCELLULOSE*
*TNT*
By-Products
Demilitarization of conventional ordnance: Priorities for database assessments of environmental contaminants, 12:37584 (R;US)
Chemical Reactions
Hot-spot reaction in unsustained shocks, 12:37582 (R;US)
Decomposition
Demilitarization of conventional ordnance: Priorities for database assessments of environmental contaminants, 12:37584 (R;US)
Ignition
The shell model for hot-spot ignition, 12:37581 (R;US)
Shock Waves
Hot-spot reaction in unsustained shocks, 12:37582 (R;US)
CHEMICAL FEEDSTOCKS
Forecasting
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
Market
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
Supply and Demand
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
CHEMICAL INDUSTRY
Hazardous Materials
Information profiles on potential occupational hazards: benzoin, 12:37633 (R;US)
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)
Organic Compounds
VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)
Pipelines
Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
Separation Processes
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
Storage Facilities
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
CHEMICAL MUTAGENS
*See MUTAGENS*
CHEMICAL PLANTS
*See also PETROCHEMICAL PLANTS*
Safety Engineering
Safety characteristics of polynary fuel/air mixtures and self-disintegrating substances, 12:37443 (R;DE;In German)
CHEMICAL REACTION KINETICS
*See also COMBUSTION KINETICS*
Data Analysis
Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)
CHEMICAL REACTIONS
*See also DENITRIFICATION*
*DESULFURIZATION*
*FISCHER-TROPSCH SYNTHESIS*
*HYDROGENATION*
*ISOMERIZATION*
*METHANATION*
*OXIDATION*
*REDUCTION*
*REFORMER PROCESSES*

**Catalysts**
Catalyst accessibility in high volatile bituminous coal: Quarterly report, 12:36316 (R;US)

**CHEMICAL REACTORS**
*See also RETORTS*
STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)
**Column Packing**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)
**Deposits**
Vacuum still bottoms viscometer, 12:36289 (B;US)
**Design**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Materials**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Packed Bed**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)
**Pressure Release**
Coal slurry letdown device, 12:36245 (RA;US)
**Scale Control**
The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system, 12:36676 (BA;US)

**CHEMICAL WARFARE**
**Human Factors Engineering**
Air Force Technical Objectives Document, Fiscal Year 1988. Annual report, January 1986-January 1987, 12:37185 (R;US)

**CHEMICALS**
*See CARCINOGENS*
*CHELATING AGENTS*
*DYES*
*MUTAGENS*
*SOLVENTS*
*SURFACTANTS*

**CHEMISTRY**
*See also RADIATION CHEMISTRY*
**Research Programs**
Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87, 12:37197 (R;US)

**CHERNOBYLSK-4 REACTOR**
**Transfrontier Contamination**
Results of the activity measurements after the reactor accident in Chernobyl, 12:37710 (R;DE;In German)

**CHEST**
**Acceleration**
Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field, 12:38015 (TG;US)

**CHINA**
**Fuel Supplies**
The petroleum resources of China, 12:36381 (R;US)

**CHINESE BEAN OIL**
*See SOYBEAN OIL*

**CHINESE HAMSTER OVARY CELLS**
*See CHO CELLS*

**CHLOR-ALKALI INDUSTRY**
*See CHEMICAL INDUSTRY*

**CHLORELLA**
**Production**
Algal biomass from farm waste. A pilot plant study, 12:36628 (R;GB)

**CHLORIDES**
*See also CALCIUM CHLORIDES*
*MAGNESIUM CHLORIDES*
*POTASSIUM CHLORIDES*
*SILVER CHLORIDES*
*SODIUM CHLORIDES*
*STRONTIUM CHLORIDES*
**Hydrolysis**
Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
**Titration**
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)

**CHLORINATED AROMATIC HYDROCARBONS**
**Chromatography**
Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985, 12:37377 (R;US)
**Ecological Concentration**
Transport of organic contaminants in coastal plain sediments, 12:37808 (R;US)
**Environmental Transport**
Transport of organic contaminants in coastal plain sediments, 12:37808 (R;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma (PCBs), 12:37675 (R;US)

**CHLOROPHYLL**
**Complexes**
Investigation of the triplet state of chlorophylls: Final report, May 1, 1975 through April 30, 1987, 12:36624 (R;US)
**Electron Transfer**
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
**Photochemical Reactions**
Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules, 12:36622 (R;US)
**Structure-Activity Relationships**
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
**Triplets**
Investigation of the triplet state of chlorophylls: Final report, May 1, 1975 through April 30, 1987, 12:36624 (R;US)

**CHO CELLS**
**Cell Killing**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
**Genetic Radiation Effects**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)

**CHONDRITES**
**Plutonium 244**
The early solar system abundance of $^{244}Pu$ as inferred from the St. Severin chondrite, 12:38070 (R;US)

**CHONDROSARCOMAS**
*See SARCOMAS*
*SKELETAL DISEASES*

**CHROMATID DELETIONS**
*See CHROMOSOMAL ABERRATIONS*

**CHROMIUM**
**Corrosion Resistance**
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
**Toxicity**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)

**CHROMIUM ALLOYS**
*See also ALLOY-IN-100*
*NICKEL-CHROMIUM STEELS*
*STAINLESS STEELS*
**Corrosion**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
**Ion Implantation**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
**Oxidation**
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
**Passivation**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)

**CHROMIUM CARBIDES**
**Corrosion Resistance**
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
**CHROMIUM-MOLYBDENUM STEELS**
*See also ALLOY-HT-9*
**Protective Coatings**
Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)
**Welding**
Investigations at the Welding Institute, 12:37237 (RA;US)
**CHROMODYNAMICS**
*See QUANTUM CHROMODYNAMICS*
**CHROMOSOMAL ABERRATIONS**
**Radioinduction**
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)
**CHROMOSOME ABERRATIONS**
*See CHROMOSOMAL ABERRATIONS*
**CHROMOSOME EXCHANGES**
*See CHROMOSOMAL ABERRATIONS*
**CHROMOSOME FRAGMENTS**
*See CHROMOSOMAL ABERRATIONS*
**CHUKCHI SEA**
**Ice**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**Petroleum Industry**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**CIRCUITS (ELECTRONIC)**
*See ELECTRONIC CIRCUITS*
**CIRCULAR POINT COLLECTORS**
*See PARABOLIC DISH COLLECTORS*
**CISTRONS**
*See GENES*
**CITIES**
*See URBAN AREAS*
**CLASSICAL MECHANICS**
**Oscillations**
Isynchronous motion in classical mechanics, 12:38312 (J;US)
**CLATHRATES**
**Recovery**
Coal liquefaction with liquid clathrates, 12:36264 (RA;US)
**Regeneration**
Coal liquefaction with liquid clathrates, 12:36264 (RA;US)
**CLEAN WATER ACT**
*Prior to April 1980, FEDERAL WATER POLLUTION CONTROL ACT was used to index this concept.*
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)
Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)
**CLIMATES**
**Biological Indicators**
Current status of X-ray densitometry, 12:37764 (RA;US)
Dendrochronological study of oak trunks found in bogs in northwest Germany, 12:38025 (RA;US)
Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects), 12:37761 (RA;US)
Progress in the image analysis of tree rings, 12:38033 (RA;US)
Some applications of the Kalman filter to tree-ring analysis, 12:37760 (RA;US)
**Environmental Effects**
Dating landslides in Hudson Bay area, Quebec, 12:38023 (RA;US)
Dendrochronological study of oak trunks found in bogs in northwest Germany, 12:38025 (RA;US)
Environmental stresses and residual variation in European tree-ring data after climatic influence is removed, 12:38030 (RA;US)
Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)
Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
Red spruce tree-ring density and growth decline, 12:37753 (RA;US)
Spatial distribution of light-ring years in subarctic Quebec, 12:37741 (RA;US)
**Variations**
Biological inference from growth-climate correlations in balsam poplar in Alaska, 12:37742 (RA;US)
Current status of X-ray densitometry, 12:37764 (RA;US)
Environmental factors involved in the growth and distribution of post oak in the southcentral United States, 12:37739 (RA;US)
Environmental stresses and residual variation in European tree-ring data after climatic influence is removed, 12:38030 (RA;US)
Extended growth decreases in New England are limited to red spruce and balsam fir, 12:37737 (RA;US)
Growth-rate trends of pines since 1930 in the northeastern United States, 12:37944 (RA;US)
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
New analysis of branches, boles, and roots for predicting historical changes in photosynthesis, respiration, and carbon allocation below ground, 12:37733 (RA;US)
Potential physiological and ecological effects of increasing $CO_2$ on forests, 12:37948 (RA;US)
**CLOSED-CYCLE COOLING SYSTEMS**
**Desiccants**
Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986, 12:37079 (R;US)
**CLOUDS**
*Limited to clouds in the earth atmosphere; for interstellar clouds see COSMIC DUST or COSMIC GASES.*
**Atmospheric Chemistry**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**CLUSTERS (STAR)**
*See STAR CLUSTERS*
**CMEA**
*See COMECON*
**COAL**
*See also SUBBITUMINOUS COAL*
**Activation Analysis**
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986 (Around a borehole), 12:36313 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, March 15, 1986-June 15, 1986 (Around a borehole), 12:36314 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986, 12:36312 (R;US)
**Ashes**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Bioconversion**
Biodegradation and bioconversion of coals by fungi: Technical report No. 7 for the period March 1, 1987-May 31, 1987, 12:36315 (R;US)
The solubilization of low-ranked coals by microorganisms, 12:36295 (R;US)

**Biodegradation**
Biodegradation and bioconversion of coals by fungi: Technical report No. 7 for the period March 1, 1987-May 31, 1987, 12:36315 (R;US)
**Boilers**
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
**Chemical Reactions**
Catalyst accessibility in high volatile bituminous coal: Quarterly report, 12:36316 (R;US)
**Cleaning**
America's clean coal commitment, 12:36235 (R;US)
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 7, March 1, 1987-May 31, 1987, 12:36269 (R;US)
**Coking**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**Combustion**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Combustion Kinetics**
Laser-induced fluorescence detection of mineral vaporization species, 12:36358 (RA;US)
**Combustion Products**
Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
**Comminution**
Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)
**Computerized Tomography**
X-ray Computed Tomography of coal: Final report, 12:36299 (R;US)
**Crushing**
An automated microscopic method for the determination of pyrite size distributions in crushed coal, 12:36298 (R;US)
**Deashing**
Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987, 12:36237 (R;US)
Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Demineralization**
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Derivatization**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**Desulfurization**
Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987, 12:36237 (R;US)
Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)
Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
Use of basic nitrogen to chemically clean coal: Quarterly report No. 3 for the period March 16, 1987 to June 15, 1987, 12:36238 (R;US)
**Electrolysis**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**Electron Spin Resonance**
Catalyst accessibility in high volatile bituminous coal: Quarterly report, 12:36316 (R;US)
**Electrophoresis**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Evaluation**
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)
**Flotation**
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
**Flow Models**
Pneumatic transport of coal by steam, 12:36350 (B;US)
**Fluidized-Bed Combustion**
Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)
Materials for FBC [fluidized-bed combustion] air heater applications, 12:36351 (R;US)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Fuel Slurries**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Gravimelt Process**
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Hydraulic Transport**
Pneumatic transport of coal by steam, 12:36350 (B;US)
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**Hydrogenation**
Catalytic coprocessing: Effect of catalyst type and sequencing, 12:36281 (J;US)
Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)
Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987, 12:36270 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Mathematical Models**
Characterization of pore structure changes during gasification, 12:36288 (B;US)
**Methylation**
Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)
**Molecular Structure**
Host/guest structure concept and the thermolysis of coal, 12:36324 (BA;NL)
Oxidation and coal structure, 12:36322 (BA;NL)
**Oxidation**
Oxidation and coal structure, 12:36322 (BA;NL)
Surface chemical problems in coal flotation, 12:36234 (R;US)
Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)

The solubilization of low-ranked coals by microorganisms, 12:36295 (R;US)

**Particle Size**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
In-situ particle characterization, 12:36307 (RA;US)

**Pneumatic Transport**
Reduction of erosion in elbows due to flow field modifications, 12:36347 (RA;US)

**Pyrolysis**
Host/guest structure concept and the thermolysis of coal, 12:36324 (BA;NL)
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms, 12:36296 (R;US)

**Radioactivity**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)

**Slurry Pipelines**
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)

**Solids Flow**
Advanced research in instrumentation and control technology: capacitance flowmeter, 12:36243 (RA;US)

**Structural Chemical Analysis**
Characterization of pore structure changes during gasification, 12:36288 (B;US)
Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)

**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
Documentation of the resource allocation and mine costing (RAMC) model: Methodology description, 12:36984 (R;US)

**Surface Area**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)

**Swelling**
Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)

**Washing**
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)

**Wettability**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)

**Wetting Heat**
An experimental study of heat of immersion of coal, 12:36292 (R;US)
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)

**X-Ray Diffraction**
Characterization of pore structure changes during gasification, 12:36288 (B;US)

**COAL CHEMICALS**
*See COAL EXTRACTS*

**COAL EXTRACTS**
**Electron Spin Resonance**
Temperature dependence of the electron spin resonance spectra of a coal-derived vacuum distillation residue and components, 12:36320 (J;US)

**COAL FINES**
**Pelletizing**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)

**COAL GAS**
**Chemical Analysis**
Advanced coherent Raman diagnostics for coal gasification streams, 12:36304 (RA;US)
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)

**Cleaning**
High-temperature control of contaminants in coal-derived gases, 12:36283 (BA;US)

**Combustion Kinetics**
Deposition effects in pressurized combustion of coal-derived fuels, 12:36357 (RA;US)

**Desulfurization**
High-temperature desulfurization of coal gas for gas turbine and fuel cell application, 12:36259 (RA;US)

**Hot Gas Cleanup**
Applications of separations technology for the control of pollutants in advanced coal combustion systems, 12:36336 (BA;US)

**Monitoring**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
Optical detection of alkali compounds, 12:36302 (RA;US)

**Multi-Element Analysis**
Development of inductively coupled plasma spectroscopy for on-line analysis, 12:36300 (RA;US)

**Toxicity**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)

**COAL GASIFICATION**
*See also TOSCOAL PROCESS*
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)

**Chemical Reaction Kinetics**
Characterization of pore structure changes during gasification, 12:36288 (B;US)
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 December 1986-15 March 1987 (Effect of activated diffusion in small pores), 12:36271 (R;US)
SNG from coal is a viable and required future energy supply option, 12:36285 (BA;US)

**Measuring Instruments**
Opening remarks: instrumentation, components, and materials contractors meeting, 12:36242 (RA;US)

**Toscoal Process**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)

**COAL GASIFICATION PLANTS**
**Computerized Control Systems**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)

**Corrosion Resistant Alloys**
Development of iron aluminides for gasification systems, 12:36251 (RA;US)

**Data Acquisition Systems**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)

**Flow Regulators**
Alternative flow control nozzles: energy dissipation of highly erosive fluids, 12:36247 (RA;US)

**Flowmeters**
Advanced research in instrumentation and control technology: capacitance flowmeter, 12:36243 (RA;US)

**Materials Testing**
Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
**Pressure Regulators**
Fluid friction control valve, 12:36248 (RA;US)
**Pressure Vessels**
Reduced girth seam weldments for heavy-walled vessels, 12:36249 (RA;US)
**Seals**
High-temperature rotating shaft seal, 12:36253 (RA;US)
**Technology Assessment**
Gasification island concept systems, 12:36257 (RA;US)
**Valves**
Coal slurry letdown device, 12:36255 (RA;US)
**Waste Water**
Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)

COAL LIQUEFACTION
*See also H-COAL PROCESS*
*TSL PROCESS*
**Catalysts**
A two-stage bench scale catalytic reactor system, 12:36290 (B;US)
Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)
Disposable catalysts in coal liquefaction, 12:36282 (BA;NL)
Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987, 12:36272 (R;US)
Strong acids as catalysts for the direct liquefaction of coal (Superacids), 12:36263 (RA;US)
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Chemical Reaction Kinetics**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
**Chemical Reactors**
A two-stage bench scale catalytic reactor system, 12:36290 (B;US)
**Fuel Oils**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Hydrogen Transfer**
Disposable catalysts in coal liquefaction, 12:36282 (BA;NL)
Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86, 12:36266 (R;US)
**Synthetic Petroleum**
Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)
**Yields**
Coal liquefaction with liquid clathrates, 12:36264 (RA;US)

COAL LIQUEFACTION PLANTS
**Chemical Reactors**
Vacuum still bottoms viscometer, 12:36289 (B;US)
**Flow Regulators**
Alternative flow control nozzles: energy dissipation of highly erosive fluids, 12:36247 (RA;US)
**Fouling**
Vacuum still bottoms viscometer, 12:36289 (B;US)
**Pressure Regulators**
Fluid friction control valve, 12:36248 (RA;US)
**Valves**
Coal slurry letdown device, 12:36255 (RA;US)
Slurry valve development, 12:36246 (RA;US)
**Viscosimeters**
Vacuum still bottoms viscometer, 12:36289 (B;US)

COAL LIQUIDS
**Catalytic Cracking**
Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)
**Chemical Analysis**
Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high molecular weight coal components, 12:36301 (RA;US)
**Deashing**
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)
**Electron Spin Resonance**
Temperature dependence of the electron spin resonance spectra of a coal-derived vacuum distillation residue and components, 12:36320 (J;US)
**Fractionation**
Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)
**Hydrogenation**
Improved catalysts for coal liquefaction: Quarterly report No. 11 for the period March 1, 1987 to May 31, 1987, 12:36267 (R;US)
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Mass Spectroscopy**
Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)
**Mixing Heat**
Thermodynamics of molecular interactions in coal liquids: Progress report for the period July-December 1986, 12:36260 (R;US)
**Recycling**
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)
**Structural Chemical Analysis**
Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)
**Thermodynamic Properties**
Thermodynamics of molecular interactions in coal liquids: Progress report for the period July-December 1986, 12:36260 (R;US)
**Toxicity**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)

COAL MINES
**Feasibility Studies**
Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations, 12:36365 (R;US)
**Fires**
Wood crib fires in a ventilated tunnel. Report of Investigations/1986, 12:36366 (R;US)
**On-Site Power Generation**
Preliminary feasibility study of a coal mine at Chicago Creek, Alaska. Summary report. Report of investigations, 12:36365 (R;US)
**Underground Mining**
Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986, 12:36342 (R;US)

COAL MINING
**Geologic Structures**
Thick-seam mining in the Western United States--geological considerations. Information Circular/1986, 12:36343 (R;US)
**Surface Mining**
Hydrologic models of surface-mined areas. Technical report, 12:36341 (R;US)

**COAL PREPARATION**
*See also HEAVY MEDIA SEPARATION*
**Economics**
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report, 12:36364 (R;US)
**Feasibility Studies**
Coal cleaning employing quaternary salts: Annual report, March 1, 1986-February 28, 1987, 12:36239 (R;US)
**Flotation**
Autogenous process for low-ash and low-sulfur coal production: Technical progress report, April 1, 1987-June 30, 1987, 12:36237 (R;US)
Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87, 12:36236 (R;US)
Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
Surface chemical problems in coal flotation, 12:36234 (R;US)
**Grinding**
Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87, 12:36236 (R;US)
Fine grinding and flotation to desulfurize coal, 12:36228 (R;US)
**Research Programs**
FY 86 in-house coal preparation research at DOE's Pittsburgh Energy Technology Center, 12:36231 (R;US)
**Reviews**
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**Technology Assessment**
Applications of separations technology for the control of pollutants in advanced coal combustion systems, 12:36336 (BA;US)
**COAL PREPARATION PLANTS**
**Flowsheets**
Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87, 12:36236 (R;US)
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**COAL RESERVES**
**Sulfur Content**
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**COAL SEAMS**
**Degassing**
An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado, 12:36447 (BA;US)
Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)
Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs, 12:36446 (BA;US)
The influence of reservoir properties and geologic setting on coalbed fracturing and production: A preliminary evaluation of the TEAM project, 12:36444 (BA;US)
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**Fracturing**
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**Gas Saturation**
An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado, 12:36447 (BA;US)
**Injection Wells**
Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)
**Mathematical Models**
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**Permeability**
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**Porosity**
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)
**COAL TAR**
**Aerosols**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**COAL-DERIVED LIQUIDS**
*See COAL LIQUIDS*
**COAL-OIL MIXTURES**
*See COAL*
*FUEL OILS*
*FUEL SLURRIES*
**COARSE MESH METHOD**
*See FINITE DIFFERENCE METHOD*
**COAST**
*See SHORES*
**COASTAL REGIONS**
**Air Pollution**
Analysis and evaluation of statistical coastal fumigation models, 12:37640 (R;US)
**COATINGS**
*See also ANTIREFLECTION COATINGS*
**Corrosion Resistance**
Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)
**Radiation Attenuation Testing**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**Thickness**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**X-Ray Radiography**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**COBALT**
**Catalytic Effects**
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1, 12:36598 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2, 12:36599 (R;FR;In French)
**COBALT 59 TARGET**
**Alpha Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**COBALT ALLOYS**
*See also ALLOY-IN-100*
**Corrosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Erosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**COBALT COMPLEXES**
**Crystal Structure**
The spectroscopy and structure of novel high energy-high density compounds: Final progress report, May 1, 1985-July 31, 1986, 12:37391 (R;US)
**Nitration**
The spectroscopy and structure of novel high energy-high density compounds: Final progress report, May 1, 1985-July 31, 1986, 12:37391 (R;US)

**COBALT COMPOUNDS**
**Reduction**
Properties of lanthanide oxides as supports for transition metal catalysts: Progress report for the period May 1, 1986 to April 30, 1987, 12:37333 (R;US)
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)
**COGENERATION**
*Prior to November 1980, this concept was indexed to CO-GENERATION.*
*See COGENERATION*
Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
Slow speed coal/water slurry fired diesels in industrial cogeneration: Market evaluation, 12:37135 (R;US)
**Load Management**
Optimized load distribution in supply systems with combined heat and power generation in consideration of the district heating network, 12:37146 (R;DE;In German)
**Optimization**
Optimized load distribution in supply systems with combined heat and power generation in consideration of the district heating network, 12:37146 (R;DE;In German)
**COHERENT ANTI-STOKES RAMAN SPECTROSCOPY**
*See RAMAN SPECTROSCOPY*
**COKE**
**Chemical Reaction Kinetics**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**COKE OVENS**
**Temperature Distribution**
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**COKE-OVEN GAS**
*See COAL GAS*
**COKING**
**Catalysts**
Effect of pore-distributed coke on catalyst regeneration kinetics, 12:36284 (B;US)
**Diagnostic Techniques**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**Heat Transfer**
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**Mathematical Models**
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**COKING PLANTS**
**Hazardous Materials**
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
**COLD PLASMA**
**Electric Fields**
Limits on the cross-field propagation of streams of cold plasma, 12:38360 (J;US)
**Stopping Power**
Limits on the cross-field propagation of streams of cold plasma, 12:38360 (J;US)
**COLLAGEN**
**Biosynthesis**
Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts, 12:37971 (RA;US)
**COLLEGES**
*See EDUCATIONAL FACILITIES*
**COLLIDING BEAMS**
**Beam-Beam Interactions**
Beamstrahlung from colliding electron-positron beams with negligible disruption, 12:37545 (J;NL)
**COLLIERIES**
*See COAL MINES*
**COLLISIONAL PLASMA**
**ECR Heating**
Effect of trapped electrons on current drive, 12:38358 (J;US)
**Lower Hybrid Heating**
Effect of trapped electrons on current drive, 12:38358 (J;US)
**Trapped-Particle Instability**
Effect of trapped electrons on current drive, 12:38358 (J;US)
**COLLISIONLESS PLASMA**
**Plasma Instability**
Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
**Shock Waves**
Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
**Turbulence**
Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
**COLLISIONS**
*For low-energy interactions involving photons, electrons, ions, atoms, and molecules; not for NUCLEAR REACTIONS; for elementary particles and radiations see also INTERACTIONS.*
**Absorption Spectra**
Master-equation approach to collisionally induced absorption and emission, 12:38093 (R;US)
**Photon Emission**
Master-equation approach to collisionally induced absorption and emission, 12:38093 (R;US)
**COLLODION**
*See NITROCELLULOSE*
**COLLOIDS**
*See also EMULSIONS*
*FOAMS*
**Electric Fields**
Particle compaction with alternating electric fields: The effects of electrode geometry, 12:37428 (BA;US)
**Electrochemistry**
Particle compaction with alternating electric fields: The effects of electrode geometry, 12:37428 (BA;US)
**COLOGNE SPIRITS**
*See ETHANOL*
**COLORADO**
**Coal Mines**
An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado, 12:36447 (BA;US)
**Natural Gas Fields**
An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado, 12:36442 (BA;US)
**COLUMBIUM**
*See NIOBIUM*
**COLUMN PACKING**
**Performance**
Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries, 12:37358 (J;US)
**COLUMNS (MECHANICAL)**
*See MECHANICAL STRUCTURES*
**COMBINED GAS AND STEAM CYCLE POWER PLANTS**
*See COMBINED-CYCLE POWER PLANTS*
**COMBINED STEAM-POWER GENERATION**
*See COGENERATION*
**COMBINED-CYCLE POWER PLANTS**
*Prior to March, 1976, the descriptors COMBINED CYCLES and FOSSIL-FUEL POWER PLANTS or THERMAL POWER PLANTS were used for indexing this concept.*
**Availability**
Availability analysis of an integrated gasification-combined cycle: Final report, 12:36751 (R;US)
**Design**
Availability analysis of an integrated gasification-combined cycle: Final report, 12:36751 (R;US)
**Reliability**
Availability analysis of an integrated gasification-combined cycle: Final report, 12:36751 (R;US)
**Technology Assessment**
Gasification island concept systems, 12:36257 (RA;US)
**COMBUSTION**
*See also FLUIDIZED-BED COMBUSTION*
*IN-SITU COMBUSTION*
*REVERSE COMBUSTION*

**Air Pollution**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Diagnostic Techniques**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**Mathematical Models**
Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)

**COMBUSTION CHAMBERS**
**Composite Materials**
Advanced composite combustor structural concepts program. Final Report, 12:37343 (R;US)
**Gases**
Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)
**Temperature Control**
Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)
**Turbulent Flow**
Prediction of recirculation zones in isothermal coaxial jet flows relevant to combustors, 12:37494 (R;US)

**COMBUSTION KINETICS**
**Mathematical Models**
Remarks on the stability analysis of reactive flows, 12:37442 (R;US)

**COMBUSTION PRODUCTS**
**Air Pollution**
Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Air Pollution Abatement**
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
**Dusts**
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
**Exhaust Gases**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Flue Gas**
Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
**Gas Chromatography**
Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
**Hydrochloric Acid**
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
**Materials Recovery**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**Particulates**
Particle evolution in MHD systems, 12:37005 (R;US)
**Recovery**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)
**Toxic Materials**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)

**COMBUSTORS**
*See also FLUIDIZED-BED COMBUSTORS*
*PULSE COMBUSTORS*
**Design**
Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987, 12:36361 (R;US)
Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)
**Measuring Instruments**
Opening remarks: instrumentation, components, and materials contractors meeting, 12:36242 (RA;US)
**Monitoring**
Fiber optic instrumentation development, 12:36305 (RA;US)
**Vents**
Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)

**COMECON**
**Trade**
Energy trade within Comecon, 12:36989 (RA;SE)

**COMMERCIAL BUILDINGS**
**Energy Consumption**
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)
Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues, 12:37073 (R;US)
**Energy Efficiency**
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)
**Energy Efficiency Standards**
Energy-efficient new commercial buildings in the Northwest Region: A compilation of measured data, 12:37066 (R;US)
**Fuel Cell Power Plants**
Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
**Load Management**
Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues, 12:37073 (R;US)
**Peak Load**
Energy use and peak power for new commercial buildings from the BECA-CN [Buildings Energy-Use Compilation and Analysis] data compilation: Key findings and issues, 12:37073 (R;US)

**COMMUNICATIONS**
*See also DATA TRANSMISSION*
**Data Transmission Systems**
Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)
**Manuals**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)
**Physical Radiation Effects**
System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1, 12:37580 (R;US)
**Security**
A natural taxonomy for digital information authentication schemes, 12:38399 (R;US)
Authentication codes that permit arbitration, 12:38398 (R;US)
Reliable communications in a network with unreliable key distribution centers, 12:36565 (R;US)

**COMMUNITIES**
**Occupational Safety**
Fence: where the community and the workplace meet, 12:37889 (R;US)
**Public Health**
Fence: where the community and the workplace meet, 12:37889 (R;US)

**COMPACT IGNITION TOKAMAK**
*A Tokamak proposed as a next-step after TFTR, i.e., for extensive ignited-core studies.*
One and two dimensional radiation analysis of the compact ignition tokamak, 12:38369 (R;US)
**Research Programs**
The ignition physics study group supports the compact ignition tokamak and engineering test reactor programs, 12:38376 (R;US)
**COMPACT TORUS**
*Prior to October 1982, this concept was indexed to THERMONUCLEAR DEVICES or to a particular experiment if known, e.g., REVERSE-FIELD PINCH.*
**Research Programs**
Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**Reverse-Field Pinch**
Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**COMPLEX TERRAIN**
**Air Pollution**
Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version), 12:37663 (R;US)
Rocky Mountain acid deposition model assessment: review of existing mesoscale models for use in complex terrain, 12:37659 (R;US)
**COMPLEXING AGENTS**
*See CHELATING AGENTS*
**COMPOSITE MATERIALS**
*See also CERMETS*
*SUPERCONDUCTING COMPOSITES*
**Chemical Preparation**
Preparation of Al/sub 2/O/sub 3/-ZrO/sub 2/ composites by adjustment of surface chemical behavior, 12:37308 (BA;US)
**Damping**
Material damping measurements of 2-d carbon-carbon composite beams. Master's thesis, 12:37324 (R;US)
**Density**
Effect of infiltration conditions on the properties of SiC/Nicalon composites, 12:37301 (R;US)
**Electric Conductivity**
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
**Flexural Strength**
Effect of infiltration conditions on the properties of SiC/Nicalon composites, 12:37301 (R;US)
**Heat Transfer**
Conduction of heat from a planar wall with uniform surface temperature to a monodispersed suspension of spheres, 12:37503 (J;US)
**Materials Testing**
Kevlar/epoxy laminates: Mechanical response of as-fabricated and shock-loaded materials (Rocket motorcase materials), 12:37350 (R;US)
**Porosity**
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
**Powder Metallurgy**
High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)
**Thermal Conductivity**
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
**Thermodynamic Properties**
Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
**Ultrasonic Testing**
Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)
**Wave Propagation**
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
**COMPOSITE MODELS**
*See also QUARK MODEL*
Compositeness below 1 TeV, 12:38194 (RA;US)
**COMPOUND NUCLEI**
**Decay**
Evolution of nuclear structure with spin and temperature, 12:38281 (BA;DE)
**COMPOUND PARABOLIC CONCENTRATORS**
**Efficiency**
Development of an efficient and inexpensive concentrating solar collector, 12:36702 (R;DK;In Danish)
**COMPOUNDS (INORGANIC)**
*See INORGANIC COMPOUNDS*
**COMPOUNDS (ORGANIC)**
*See ORGANIC COMPOUNDS*
**COMPRESSIBLE FLOW**
**Mathematical Models**
Remarks on the stability analysis of reactive flows, 12:37442 (R;US)
**COMPRESSION STRENGTH**
**Experimental Data**
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand (Crushed salt: bentonite = 70:30 by weight), 12:36535 (R;US)
**COMPRESSORS**
**Design**
Efficient refrigerators with small compressors, 12:37075 (R;DK;In Danish)
**COMPUTER ARCHITECTURE**
Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987, 12:38402 (R;US)
**ADA**
Strategic Defense Initiative ADA (trade name) Process Description Language, Version 1.00. Final report, 12:37186 (R;US)
**Optimization**
Optimal partitioning and redundancy removal in computing partial sums. Technical report (Final) December 1985-January 1987, 12:38405 (R;US)
**Performance**
Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)
**COMPUTER CODES**
*Computer codes are indexed by their initial letter and CODES, e.g., A CODES. If the code name begins with a number the code is indexed to NUMBER CODES.*
*See also A CODES*
*B CODES*
*D CODES*
*F CODES*
*G CODES*
*I CODES*
*P CODES*
*Q CODES*
*R CODES*
*S CODES*
*T CODES*
*V CODES*
*X CODES*
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report (Report includes program on a disk in pocket), 12:36364 (R;US)
**Accuracy**
Code uncertainty quantification, 12:36879 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
**Comparative Evaluations**
Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)

**Documentation**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Quality Assurance**
Geologic software for nuclear waste repository studies: A quality assurance program, 12:36529 (R;US)
**S Codes**
Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)

**COMPUTER NETWORKS**
**Computer Codes**
VMS software for the Jorway-411 interface, 12:38408 (R;US)
**Distributed Data Processing**
Trace-driven simulation study of dynamic load balancing. Technical report, 7 August 1984-6 August 1987, 12:38416 (R;US)
**Manuals**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)
**Operation**
Aspects of computing in high energy physics, 12:38109 (RA;US)
**Programming**
A multiple node software development environment, 12:38410 (R;US)

**COMPUTER PROGRAMS**
*See COMPUTER CODES*

**COMPUTER-AIDED DESIGN**
**Manuals**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)

**COMPUTER-AIDED MANUFACTURING**
**Manuals**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)

**COMPUTERIZED CONTROL SYSTEMS**
**Computer Architecture**
The CEBAF [Continuous Electron Beam Accelerator Facility] control system architecture, 12:37531 (R;US)
**Performance Testing**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)

**CONCRETES**
**Fluid-Structure Interactions**
Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)
**Performance Testing**
Small-Scale Seal Performance Test Series "A" thermal/structural data through the 180th day (Concrete seals), 12:37347 (R;US)

**CONDENSATES**
**Qualitative Chemical Analysis**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Quantitative Chemical Analysis**
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)

**CONDENSERS (ELECTRIC)**
*See CAPACITORS*

**CONDENSERS (STEAM)**
*See STEAM CONDENSERS*

**CONDUCTIVITY (ELECTRIC)**
*See ELECTRIC CONDUCTIVITY*

**CONDUCTIVITY (THERMAL)**
*See THERMAL CONDUCTIVITY*

**CONFIGURATION INTERACTION**
*Not an interaction in the sense of INTERACTIONS.*
**Wave Functions**
The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory, 12:37402 (R;US)

**CONIFERS**
*See also PINES*
**Biological Stress**
Fire frequency and old trees in the Southern Canadian Rockies, 12:37748 (RA;US)
**Monitoring**
Thinning out of the tree crown - what is hidden in that integrated measure of forest damage, 12:37939 (RA;DE)
**Plant Growth**
Comparative studies on the annual ring pattern and crown condition of conifers (the Valais, Switzerland), 12:37754 (RA;US)
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)

**CONSERVATION (ENERGY)**
*See ENERGY CONSERVATION*

**CONSERVATION (RESOURCE)**
*See RESOURCE CONSERVATION*

**CONSTRUCTION INDUSTRY**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper: [Final report], 12:37063 (R;US)
**Hazardous Materials**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**Health Hazards**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**Technology Transfer**
Thermabilt energy efficient residential construction research, demonstration and technology transfer, 12:37059 (RA;US)

**CONTACT RADIOTHERAPY**
*See RADIOTHERAPY*

**CONTACTS (ELECTRIC)**
*See ELECTRIC CONTACTS*

**CONTAINERS**
*See also CASKS*
*PRESSURE VESSELS*
*TANKS*
**Radioactive Waste Storage**
Waste disposal package, 12:36542 (P;GB)
**Refrigeration**
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)
**Service Life**
Nuclear waste package fabricated from concrete, 12:36503 (R;US)

**CONTAINMENT**
*See also CONTAINMENT BUILDINGS*
*CONTAINMENT SYSTEMS*
**Reviews**
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)

**CONTAINMENT BUILDINGS**
**Compression Strength**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
**Shear Properties**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
**Structural Models**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)

**CONTAINMENT SYSTEMS**
**Dynamic Loads**
Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
**Failures**
Steam explosion energetics, 12:36914 (RA;US)
**Hydrogen**
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)

**Research Programs**
Containment and piping research, 12:36890 (RA;US)
**CONTAMINATION (INTERNAL)**
*See RADIONUCLIDE KINETICS*
**CONTROL ROOMS**
**Fire Hazards**
Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)
**CONTROL SYSTEMS**
*For automated processes including feedback.*
*See also COMPUTERIZED CONTROL SYSTEMS*
*ENTRY CONTROL SYSTEMS*
*REACTOR CONTROL SYSTEMS*
**Design**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
**Mathematical Models**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
**Sensitivity**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
**CONVECTIVE LOOP HOUSES**
*See DOUBLE ENVELOPE BUILDINGS*
**COOKING**
*See FOOD PROCESSING*
**COOLERS**
*See HEAT EXCHANGERS*
**COOLING SYSTEM (REACTOR)**
*See REACTOR COOLING SYSTEMS*
**COOLING SYSTEMS**
*See also CLOSED-CYCLE COOLING SYSTEMS*
*REACTOR COOLING SYSTEMS*
**Control Systems**
Single zone control systems, 12:37074 (R;US)
**Water Supply**
Study of saline water use at the Harry Allen Generating Station. Final report, 12:36756 (R;US)
**COOLING TOWER PACKING GRIDS**
*See PACKINGS*
**COPOLYMERIZATION**
**Catalysis**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**COPPER**
**Air Pollution**
Summary review of the health effects associated with copper: health issue assessment, 12:37990 (R;US)
**Catalytic Effects**
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 1, 12:36598 (R;FR;In French)
Synthesis of higher alcohols from the mixture CO+H/sub 2/. Preparation and characterization of mixed oxide catalysts based on copper and cobalt. Study of stationary state and of reaction mechanism. Vol. 2, 12:36599 (R;FR;In French)
**Corrosion**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Deformation**
High-strain-rate deformation mechanisms in copper and implications for behavior during shock-wave deformation, 12:37223 (R;US)
**Environmental Exposure Pathway**
Summary review of the health effects associated with copper: health issue assessment, 12:37990 (R;US)
**Magnetoresistance**
Radiation effects limits on superconducting magnets: Data base for copper stabilizers, 12:37243 (R;US)
**Phase Transformations**
Thermal roughening of the copper (110) surface: An x-ray diffraction experiment, 12:37247 (J;US)
**Roughness**
Thermal roughening of the copper (110) surface: An x-ray diffraction experiment, 12:37247 (J;US)
**Ruderman-Kittel Coupling**
Comment on"Realistic calculation of the indirect-exchange interaction in metals", 12:37250 (J;US)
**Toxicity**
Acute and chronic effects of water-quality-criteria-based metal mixtures on three aquatic species (journal version), 12:37997 (R;US)
**Water Pollution**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**COPPER 63**
**Gamma Spectra**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**Giant Resonance**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**COPPER ALLOYS**
*See also COPPER BASE ALLOYS*
**Order-Disorder Transformations**
X-ray scattering studies of non-equilibrium ordering processes: Progress report, August 1, 1986-October 31, 1987, 12:37217 (R;US)
**Segregation**
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
**Wear**
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
**COPPER BASE ALLOYS**
**Specific Heat**
Specific heat of heavy-fermion $CeCu_6$: Effect of pressure and magnetic field, 12:37227 (R;US)
**COPPER COMPOUNDS**
*See also COPPER OXIDES*
*COPPER SULFIDES*
**Ionic Conductivity**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**COPPER OXIDES**
**Band Theory**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Microstructure**
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
**Sorptive Properties**
Properties of CuO sorbents related to $SO_2$ reactivity, 12:36760 (R;US)
**Superconductivity**
Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/$CuO_4$, 12:37291 (R;US)
Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials, 12:37287 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/, 12:37294 (R;US)
Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O$/sub x/, 12:37288 (R;US)
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)

**Transition Temperature**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)

**COPPER SULFIDE SOLAR CELLS**
**Fabrication**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)
**Research Programs**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)

**COPPER SULFIDES**
**Deposition**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)

**CORES (REACTOR)**
*See REACTOR CORES*

**CORIUM**
**Fluid Flow**
Experimental study of isothermal and boiling liquid jets, 12:36913 (RA;US)
**Fluid-Structure Interactions**
Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)
**Inspection**
Preliminary results of the TMI-2 core bores, 12:36895 (RA;US)
**Microstructure**
TMI-2 lower vessel debris examinations, 12:36894 (RA;US)
**Radiochemical Analysis**
TMI-2 lower vessel debris examinations, 12:36894 (RA;US)
**Sampling**
Preliminary results of the TMI-2 core bores, 12:36895 (RA;US)

**CORN STOVER**
*See AGRICULTURAL WASTES*

**CORONA DISCHARGES**
**Heat Transfer**
Effects of corona on heat transfer in an enclosure. Master's thesis, 12:38099 (R;US)

**CORONA (SOLAR)**
*See SOLAR CORONA*

**CORONARIES**
**Biomedical Radiography**
NIKOS - a system for non-invasive examination of coronary arteries by means of DSA with synchrotron radiation. Pt. 2. In-vivo investigations, 12:37875 (R;DE)

**COSMIC GAMMA SOURCES**
**Particle Production**
Discovery of very high energy point sources, 12:38069 (RA;US)
**Radiation Flux**
Discovery of very high energy point sources, 12:38069 (RA;US)

**COSMIC MUONS**
*Prior to July, 1975 information was indexed to MUONS.*
**Particle Production**
Discovery of very high energy point sources, 12:38069 (RA;US)
**Radiation Flux**
Discovery of very high energy point sources, 12:38069 (RA;US)

**COSMIC NEUTRINOS**
*Prior to July, 1975 information was indexed to NEUTRINOS.*
**Particle Production**
Discovery of very high energy point sources, 12:38069 (RA;US)
**Radiation Flux**
Discovery of very high energy point sources, 12:38069 (RA;US)

**COSMIC PARTICLES**
*See COSMIC RADIATION*

**COSMIC RADIATION**
*From sources other than the sun; not for SOLAR RADIATION.*
*See also COSMIC MUONS*
*COSMIC NEUTRINOS*
**Neutron Monitors**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
**Radiation Detectors**
Space radiation studies. Annual report, November 1985-November 1986, 12:37567 (R;US)
**Threshold Rigidity**
Correlation between asymptotic directions of cosmic-ray particles and cutoff rigidities in the evolving geomagnetic field, 12:38084 (R;US)

**COSMIC X-RAY SOURCES**
**Cosmic X-Ray Bursts**
EXOSAT observations of double-peaked bursts with radius expansion from 4U/MXB 1820-30, 12:38073 (J;US)

**COSMOLOGICAL MODELS**
**String Models**
On the evolution of global strings in the early universe, 12:38057 (R;US)
**Testing**
Kinematic tests of exotic flat cosmological models, 12:38075 (J;US)
**Vacuum States**
Cosmology with decaying vacuum energy, 12:38071 (J;NL)
**Weak Interactions**
Weak interaction and the large scale structure of the universe, 12:38079 (BA;DE)

**COST ESTIMATION**
**W Codes**
Application of the WELC well cost estimating procedure, 12:36724 (R;GB)
WELC (version 1): well cost estimating, 12:36723 (R;GB)

**COTTONWOODS**
**Biological Stress**
Potential for use of cottonwoods as indicators of past floods, 12:37831 (RA;US)
**Plant Growth**
Potential for use of cottonwoods as indicators of past floods, 12:37831 (RA;US)

**COULOMB SCATTERING**
**S Matrix**
Dynamic symmetries in scattering, 12:38316 (BA;US)

**COULOMETRY**
*See VOLTAMETRY*

**COUNCIL FOR MUTUAL ECONOMIC ASSISTANCE**
*See COMECON*

**COUNTERS (RADIATION)**
*See RADIATION DETECTORS*

**COUNTY BUILDINGS**
*See PUBLIC BUILDINGS*

**COURT BUILDINGS**
*See PUBLIC BUILDINGS*

**CP INVARIANCE**
**Symmetry Breaking**
Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look, 12:38147 (R;US)

**CRACKING**
**Diagnostic Techniques**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)

**CRACKS**
**Closures**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
**Mathematical Models**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
**Stress Intensity Factors**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)

**Ultrasonic Testing**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
**Wave Propagation**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)

**CRAY COMPUTERS**
**Data Processing**
Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)

**CREEKS**
*See STREAMS*

**CREEP**
**Evaluation**
Elastic creep-fatigue evaluation for ASME [American Society of Mechanical Engineers] code, 12:37505 (R;US)

**CRESOLS**
**Solubility**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)

**CRESYLIC ACID**
*See CRESOLS*

**CREVICE CORROSION**
**Control Systems**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)
**Feedwater**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)
**Heat Distribution Systems**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)

**CRITICAL HEAT FLUX**
**Fuel Element Clusters**
Agreement of model investigations of the critical heat flux in fuel element clusters, 12:36809 (R;DE;In German)

**CRITICALITY ACCIDENTS**
*See RADIATION ACCIDENTS*

**CROPS**
**Resource Assessment**
Fuels from agricultural crops. Production estimates, cost of raw products and value of by-products, 12:36638 (R;SE;In Swedish)

**CROSSED BEAMS**
*See COLLIDING BEAMS*

**CROSSROADS PROJECT**
**Ships**
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)

**CROWN ETHERS**
*See POLYETHYLENE GLYCOLS*

**CRUDE OIL**
*See PETROLEUM*

**CRYOGENICS**
**Safety**
Pressure safety training for a large research and development facility, 12:38017 (R;US)

**CRYSTAL GROWTH**
**Mathematical Models**
Computational analyses of crystal growth. Final report, 12:37345 (R;US)

**CRYSTAL LATTICES**
**Methyl Radicals**
Molecular dynamics studies of energy transfer processes in crystal systems: Annual summary report, 12:38302 (R;US)

**CRYSTAL RIVER-3 REACTOR**
*Citrus, Florida, USA*
**Emergency Plans**
Management of emergency feedwater during natural circulation cooldown following a loss of offsite power scenario, 12:36850 (RA;US)
**Outages**
Management of emergency feedwater during natural circulation cooldown following a loss of offsite power scenario, 12:36850 (RA;US)
**Reactor Safety**
Management of emergency feedwater during natural circulation cooldown following a loss of offsite power scenario, 12:36850 (RA;US)

**CRYSTALS**
*See also LIQUID CRYSTALS*
**Electron Microscopy**
Diffraction effects from interfaces, 12:37211 (R;US)
**Impurities**
Angular-momentum theory applied to interactions in solids. Summary progress report, 12:38293 (R;US)

**CURIUM 244**
**Inhalation**
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
**Retention**
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
**Toxicity**
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)

**CUTTING**
**Chemical Analysis**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**Petroleum**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)

**CUTTING TOOLS**
**Performance Testing**
Hot tests of the small portable arc saw using an electromechanical manipulator, 12:36935 (BA;US)
**Reviews**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)

**CYCLOALKANES**
*See also CYCLOHEXANE*
**Solubility**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)
**Synthesis**
[Production and reactions of substituted dihydrofurans and thiophenes] (Cyclooctadecane), 12:37397 (R;US)

**CYCLOALKENES**
**Adsorption**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)

**CYCLOHEXANE**
**Enthalpy**
Excess molar enthalpies for the 1-butanol-benzene-cyclohexane system at 25°C, 12:37419 (J;US)

**CYCLONE SEPARATORS**
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**Performance**
Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 7, March 1, 1987-May 31, 1987, 12:36269 (R;US)

**CYLINDRICAL PARABOLIC COLLECTORS**
*See PARABOLIC TROUGH COLLECTORS*

**CYSTEINE**
**Biological Functions**
Effect of exogenous sources of cysteine on lung glutathione levels, 12:37982 (RA;US)

**CYTOCHROME OXIDASE**
**Enzyme Activity**
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)

## D

**D CODES**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**D MESONS**
*Prior to Jan. 1985 this information was indexed with the descriptor D-1865 RESONANCES.*
**Hadronic Particle Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Leptonic Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
**Particle Decay**
Search for CP violation in $B^0$ [and $D^0$] decays II: A closer look, 12:38147 (R;US)
**Particle Production**
Charm hadroproduction in pp interactions at 400 GeV/c and 800 GeV/c, 12:38141 (RA;US)
Forward-backward asymmetry for b and c quarks, 12:38172 (RA;US)
Granlibakken meeting: b and c quark summary, 12:38187 (RA;US)
Physics from PEP, 12:38134 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
Results from PETRA, 12:38135 (RA;US)
Study of $D^+ \rightarrow K^- \pi^+ \pi^+$ selection using the vertex drift chamber, 12:38188 (RA;US)
**Radiative Decay**
Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
**Semileptonic Decay**
Theoretical understanding of charm decays, 12:38191 (RA;US)
**Weak Hadronic Decay**
Heavy quark spectroscopy and decay, 12:38130 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
Results from PETRA, 12:38135 (RA;US)
Theoretical understanding of charm decays, 12:38191 (RA;US)
**Weak Particle Decay**
An upper limit on the decay $D^0 \rightarrow \mu e$, 12:38148 (R;US)
**D PLUS RESONANCES**
*See D MESONS*
**D ZERO RESONANCES**
*See D MESONS*
**D-1865 RESONANCES**
*See D MESONS*
**DAIRY INDUSTRY**
**Heat Recovery**
The use of recovered heat for preheating air to spray driers, 12:37147 (R;NZ)
**Separation Processes**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**Waste Heat Utilization**
The use of recovered heat for preheating air to spray driers, 12:37147 (R;NZ)
**DARK MATTER**
*See NONLUMINOUS MATTER*
**DATA ACQUISITION SYSTEMS**
**Computer Codes**
List processing software for the LeCroy 1821 Segment Manager Interface, 12:38409 (R;US)
**Data Processing**
Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
**Design**
Data acquisition for high energy physics experiments, 12:37553 (RA;US)
**Digitizers**
Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)
**Interfaces**
List processing software for the LeCroy 1821 Segment Manager Interface, 12:38409 (R;US)
**Performance**
Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)
**Performance Testing**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)
Ultrasonic detection of weld bead geometry, 12:37270 (BA;US)
**Spatial Resolution**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)
**Video Tapes**
Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)
**DATA TRANSMISSION**
**Manuals**
A guide to telecommunications at Brookhaven National Laboratory, 12:38418 (R;US)
**DATA TRANSMISSION SYSTEMS**
Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)
**DAYLIGHTING**
**Design**
A concept for an advanced computer-based building envelope design tool, 12:37072 (R;US)
**DECANE**
**Phase Diagrams**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**DECARBOXYLASE**
*See DECARBOXYLASES*
**DECARBOXYLASES**
**DNA Sequencing**
Promoter and nucleotide sequences of the Zymomonas mobilis pyruvate decarboxylase, 12:37867 (J;US)
**DEFECTS**
*Not for CRYSTAL DEFECTS.*
**Computerized Simulation**
Computation of fields and signals due to ferromagnetic anomalies, 12:37268 (BA;US)
**Detection**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**Image Processing**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)
**Wave Propagation**
Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
**DEFENSE**
*See NATIONAL DEFENSE*
**DEFORMATION**
**Data Acquisition Systems**
The Cliper Data Acquisition System, 12:37594 (R;US)
**DEGREE DAYS**
**Data**
Heating days in Switzerland. Recommendation. Version 1982, 12:37724 (R;DE;In German)
**Standards**
Heating days in Switzerland. Recommendation. Version 1982, 12:37724 (R;DE;In German)

**DEHYDROGENASES**
*See OXIDOREDUCTASES*
**DELAYED NEUTRON PRECURSORS**
**Neutron Emission**
1986 evaluation of delayed-neutron emission probabilities, 12:38245 (R;US)
**DELAYED NEUTRONS**
**Neutron Emission**
1986 evaluation of delayed-neutron emission probabilities, 12:38245 (R;US)
**DELETIONS (CHROMOSOMAL)**
*See CHROMOSOMAL ABERRATIONS*
**DELTA RESONANCES (MESON)**
*See MESON RESONANCES*
**DENITRIFICATION**
**Catalysts**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Chelating Agents**
Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
**Demonstration Programs**
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
**DENSITOMETERS**
**Design**
Direct reading x-ray densitometer, 12:38031 (RA;US)
**Efficiency**
Thin-section technique for X-ray densitometric analysis of narrow tree-ring series, 12:38032 (RA;US)
**DEOXIDATION**
*See REDUCTION*
**DEOXYPENTOSE NUCLEIC ACID**
*See DNA*
**DEOXYRIBONUCLEIC ACID**
*See DNA*
**DEPARTMENT OF DEFENSE**
*See US DOD*
**DEPOSITION**
*For the laying down of a substance on a surface; for deposition of elements and nuclides in tissues of living organisms use RETENTION.*
**Environmental Effects**
The role of dry deposition in acidification of waters, 12:37767 (R;US)
**Environmental Transport**
The role of dry deposition in acidification of waters, 12:37767 (R;US)
**DEPOSITS**
**Viscosity**
Vacuum still bottoms viscometer, 12:36289 (B;US)
**DEPOSITS (GEOLOGICAL)**
*See GEOLOGIC DEPOSITS*
**DESERTRON**
*See SUPERCONDUCTING SUPER COLLIDER*
**DESOXYRIBONUCLEIC ACID**
*See DNA*
**DESULFURIZATION**
**Catalysts**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Chelating Agents**
Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
**Demonstration Programs**
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
**Technology Assessment**
Flue gas desulphurisation: system performance, 12:37611 (R;GB)
**DETECTION (NUCLEAR EXPLOSIONS)**
*See NUCLEAR EXPLOSION DETECTION*
**DETECTORS (RADIATION)**
*See RADIATION DETECTORS*
**DETONATION WAVES**
**Flow Models**
Adaptive methods for high Mach number reacting flow, 12:37502 (R;US)
**Reaction Kinetics**
Adaptive methods for high Mach number reacting flow, 12:37502 (R;US)
**DETONATORS**
**Performance**
Effects of accurate MS delays on productivity, energy consumption at the primary crusher, oversize, ground vibrations and airblast, 12:36346 (BA;US)
**DEUTERIUM**
**Muon-Catalyzed Fusion**
Some thoughts on the muon catalyzed fusion reactor, 12:38320 (R;US)
**Photochemical Reactions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Pinch Effect**
High density Z pinch formed from a solid deuterium fiber, 12:38340 (R;US)
**DEUTERIUM TARGET**
**Electron Reactions**
Electroweak radiative corrections and neutral current phenomenology, 12:38112 (R;US)
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)
**DEUTERON-DEUTERON INTERACTIONS**
*See DEUTERIUM TARGET*
**DEUTERONS**
**Charge Distribution**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Electromagnetic Form Factors**
Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
**DEVELOPING COUNTRIES**
*See also BRAZIL*
*GREECE*
*ICELAND*
*INDONESIA*
*LIBERIA*
*MEXICO*
*MOROCCO*
*PHILIPPINES*
**Economic Development**
Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**Exports**
Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**Petroleum**
Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**DEVONIAN SHALES**
*See BLACK SHALES*
**DIAL PAINTERS**
**Delayed Radiation Effects**
Radium-dial workers, 12:37935 (BA;US)

**DIAMOND DRILLING EQUIPMENT**
*See DRILLING EQUIPMENT*
**DIAPHRAGMS (THERMONUCLEAR DEVICE)**
*See LIMITERS*
**DIBARYON RESONANCES**
Recent results on polarizations and the present status of the Fermilab polarized beams, 12:38110 (R;US)
**DICHLOROMETHANE**
*See METHYLENE CHLORIDE*
**DIELECTRIC PROPERTIES**
**Measuring Methods**
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)
**DIESEL ENGINES**
**Adiabatic Processes**
Testing of developmental ceramic materials in diesel engine combustion chambers, 12:37160 (R;US)
**Computerized Simulation**
Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation, 12:37164 (R;DE;In German)
**Exhaust Gases**
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)
Rapid method for determining soot content of lungs in diesel-exposed rodents, 12:37966 (RA;US)
**Fuel Economy**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Fuel Injection Systems**
Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation, 12:37164 (R;DE;In German)
**Fuel Slurries**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling, 12:37131 (R;US)
Slow speed coal/water slurry fired diesels in industrial cogeneration: Market evaluation, 12:37135 (R;US)
**Hybrid Systems**
Reliability aspects of wind/diesel hybrid generating systems, 12:36749 (BA;US)
**Marketing Research**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Performance Testing**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 6.0 Determination of accurate heat release diagrams and mechanical efficiency, 12:37133 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 4.0, Single-cylinder engine tests, 12:37132 (R;US)
Studies on the influence of tolerances in diesel fuel injection systems on the injection process and the engine operation, 12:37164 (R;DE;In German)
**Public Opinion**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Reliability**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Reviews**
Automobile engines. Design and function, 12:37163 (R;DE;In German)
**Uses**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)
**DIESEL FUELS**
**Combustion Products**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Exhaust Gases**
Control of atmospheric fine primary carbon particle concentrations. Final report, 12:37654 (R;US)
**Fuel Substitution**
Stability and composition of palm, coconut and soy oil fatty acid microemulsion diesel fuels, 12:36605 (BA;US)
**DIESEL OIL (FRACTION)**
*See DIESEL FUELS*
**DIETHYLENETRIAMINEPENTAACETIC ACID**
*See DTPA*
**DIFFUSION**
**Material Balance**
Configurational diffusion of coal macromolecules: Quarterly progress report, March 15, 1987 to June 15, 1987, 12:36317 (R;US)
**Mathematical Models**
MINC [Multiple interacting Continua]: An approach for analyzing transport in strongly heterogeneous systems, 12:38037 (R;US)
**Measuring Methods**
Configurational diffusion of coal macromolecules: Quarterly progress report, March 15, 1987 to June 15, 1987, 12:36317 (R;US)
**DIGESTER GAS**
*See METHANE*
**DIMENSIONS**
*See also THICKNESS*
**Quantization**
On the discrete reconciliation of relativity and quantum mechanics, 12:38310 (R;US)
**DIMETHYL SULFOXIDE**
*See DMSO*
**DIMETHYLBENZENES**
*See XYLENES*
**DIODES (SEMICONDUCTOR)**
*See SEMICONDUCTOR DIODES*
**DIOLS**
*See GLYCOLS*
**DIOXIN**
**Air Pollution Monitoring**
Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)
**DIRAC MONOPOLES**
*See MAGNETIC MONOPOLES*
**DISARMAMENT**
*See ARMS CONTROL*
**DISCHARGES (WASTES)**
*See WASTE DISPOSAL*
**DISPERSANTS (CHEMICAL)**
*See SURFACTANTS*
**DISPOSAL (WASTES)**
*See WASTE DISPOSAL*
**DISPROPORTIONATION**
*See OXIDATION REDUCTION*
**DISSOLVED OXYGEN**
*See OXYGEN*
**DISTRIBUTED COLLECTOR POWER PLANTS**
**Chemical Reactors**
The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system, 12:36676 (BA;US)
**Reformer Processes**
The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system, 12:36676 (BA;US)

**Thermochemical Processes**
The influence of metal surfaces on coking in a reforming/methanation thermochemical transport distributed receiver solar energy system, 12:36676 (BA;US)

**DISTRIBUTED DATA PROCESSING**
**Losses**
Effects of message loss on distributed termination. Technical report, 12:38417 (R;US)
**Task Scheduling**
Trace-driven simulation study of dynamic load balancing. Technical report, 7 August 1984-6 August 1987, 12:38416 (R;US)

**DISTRICT COOLING**
**Technology Assessment**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)
**Water Source Heat Pumps**
Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)

**DISTRICT HEATING**
**Pipes**
Acoustic leak detection for district heating systems: Results of Phase 1: Laboratory assessment, 12:37153 (R;US)
**Technology Assessment**
Proposed haymarket district heating and cooling system, Lincoln, Nebraska: Phase 1, Feasibility report, 12:37155 (R;US)
**Water Source Heat Pumps**
Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)

**DIVERTORS**
**Performance Testing**
Enhanced particle flux control in a tokamak with a resonant helical divertor, 12:38380 (R;US)

**DMSO**
**Biological Effects**
Characteristics of the formation of enzyme-bound ATP from medium inorganic phosphate by mitochondrial $F_1$ adenosinetriphosphatase in the presence of dimethyl sulfoxide, 12:37866 (J;US)

**DNA**
**Biophysics**
Liquid crystalline phases in concentrated aqueous solutions of $Na^+$ DNA, 12:37868 (J;US)
**Biosynthesis**
Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts, 12:37971 (RA;US)
**Configuration Interaction**
Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide, 12:38010 (J;US)
**Conformational Changes**
Kinetic flow dichroism study of conformational changes in supercoiled DNA induced by ethidium bromide and noncovalent and covalent binding of benzo[a]pyrene diol epoxide, 12:38010 (J;US)
**Crystal-Phase Transformations**
Liquid crystalline phases in concentrated aqueous solutions of $Na^+$ DNA, 12:37868 (J;US)
**Molecular Structure**
Electron microscopy of single-stranded structures in the DNA of competent Haemophilus influenzae cells, 12:37871 (J;US)

**DNA ADDUCTS**
**Biochemical Reaction Kinetics**
Detection of DNA adducts formed from metabolites of 1-nitropyrene and 1-8-dinitropyrene in vitro, 12:37980 (RA;US)
**Biosynthesis**
Detection of DNA adducts formed from metabolites of 1-nitropyrene and 1-8-dinitropyrene in vitro, 12:37980 (RA;US)
**Chemical Analysis**
Surface-enhanced Raman analysis of Benzo[A]Pyrene-DNA adducts on silver-coated cellulose substrates, 12:37386 (J;US)
**Tissue Distribution**
Formation of DNA adducts in mouse tissues after 1-nitropyrene administration, 12:37981 (RA;US)

**DNA HELICASES**
**DNA-Cloning**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**Enzyme Activity**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)

**DNA MISMATCH**
**DNA Repair**
[DNA repair and the regulation of replication]: Progress report for 1983-1986, 12:37863 (R;US)

**DOGS**
*See also BEAGLES*
**Survival Curves**
Annual report references to dog longevity studies in which all dogs have died, 12:37909 (RA;US)

**DOLPHINS**
*See CETACEANS*

**DOMESTIC WASTES**
*See MUNICIPAL WASTES*

**DORMITORIES**
*See RESIDENTIAL BUILDINGS*

**DOSE DISTRIBUTIONS**
*See RADIATION DOSE DISTRIBUTIONS*

**DOSE LIMITS**
**Recommendations**
Microdosimetric basis for exposure limits, 12:37932 (R;US)

**DOSE REDUCTION FACTOR**
*See RADIOPROTECTIVE SUBSTANCES*

**DOSE RELATIVE FACTOR**
*See RADIOPROTECTIVE SUBSTANCES*

**DOSE-RESPONSE RELATIONSHIPS**
Notes on the effect of dose uncertainty, 12:37902 (R;US)

**DOUBLE BETA DECAY**
**Reviews**
Nuclear structure problems in double beta decay, 12:38290 (BA;US)

**DOUBLE ENVELOPE BUILDINGS**
**Computer-Aided Design**
A concept for an advanced computer-based building envelope design tool, 12:37072 (R;US)

**DOUBLE SHELL HOUSES**
*See DOUBLE ENVELOPE BUILDINGS*

**DOUBLE WALL HOUSES**
*See DOUBLE ENVELOPE BUILDINGS*

**DOUNREAY PROTOTYPE FAST REACTOR**
*See PFR REACTOR*

**DRELL MODEL**
Massive lepton pair production - the Drell-Yan process - with nuclear targets, 12:38282 (BA;DE)

**DRF**
*See RADIOPROTECTIVE SUBSTANCES*

**DRIFT CHAMBERS**
**Design**
Electrodeless drift chambers with 50-CM drift distance, 12:37575 (BA;US)
**Performance Testing**
Electrodeless drift chambers with 50-CM drift distance, 12:37575 (BA;US)
**Readout Systems**
Accurate 2 dimensional drift tube readout using time division and vernier pads, 12:37571 (J;NL)
**Uses**
Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics, 12:37573 (J;NL)

**DRIFT INSTABILITY**
**Eigenfunctions**
Eigenmode analysis of compressional waves in the magnetosphere, 12:38350 (R;US)
**DRILL BITS**
**Design**
Initial testing and resulting redesign of the 96-inch diameter Robbins Disc Cutter Bit at the Nevada Test Site, 12:37455 (R;US)
**Performance Testing**
Initial testing and resulting redesign of the 96-inch diameter Robbins Disc Cutter Bit at the Nevada Test Site, 12:37455 (R;US)
**Testing**
Investigation of rock drilling processes with diamond cutters of peg shape, 12:36374 (RA;DE;In German)
**Wear**
Investigation of rock drilling processes with diamond cutters of peg shape, 12:36374 (RA;DE;In German)
**DRILL HOLES**
*See BOREHOLES*
**DRILL PIPES**
**Materials Handling**
Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)
**DRILL SHIPS**
*See OFFSHORE PLATFORMS*
*SHIPS*
**DRILLING EQUIPMENT**
*See also DRILL BITS*
*DRILL PIPES*
**Manufacturers**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**Reviews**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**DRILLING FLUIDS**
*Limited to materials used in well drilling.*
**Filtration**
Investigation of the structure of filter cakes from bore flushing, 12:36372 (RA;DE;In German)
**Stability**
Investigation of temperature stability of bore flushing liquids based on water, 12:36373 (RA;DE;In German)
**DRILLING MUD**
*See DRILLING FLUIDS*
**DRILLING PLATFORMS**
*See OFFSHORE PLATFORMS*
**DRILLING (ROCK)**
*See ROCK DRILLING*
**DROUGHTS**
**Biological Indicators**
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
**Environmental Effects**
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
**DRUGS**
*See also RADIOPHARMACEUTICALS*
*RADIOPROTECTIVE SUBSTANCES*
**Chemical Radiation Effects**
Influence of radiation treatment on pharmaceuticals and auxiliary ingredients. A review. Pt. 7, 12:37440 (R;DE;In German)
**Radiosterilization**
Influence of radiation treatment on pharmaceuticals and auxiliary ingredients. A review. Pt. 7, 12:37440 (R;DE;In German)
**DRY DEPOSITION**
*See DEPOSITION*
**DRY STORAGE**
**Recommendations**
Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas, 12:36494 (R;US)
**Temperature Effects**
Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas, 12:36494 (R;US)
**DRYERS**
**Field Tests**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Fluidized Beds**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Planning**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**DRYING**
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**DRY-TYPE COOLING TOWERS**
*See CLOSED-CYCLE COOLING SYSTEMS*
**DTPA**
**Infusion**
Preventing the translocation of inhaled $^{241}$Am in dogs using continuously infused DTPA, 12:37930 (RA;US)
**Intravenous Injection**
Preventing the translocation of inhaled $^{241}$Am in dogs using continuously infused DTPA, 12:37930 (RA;US)
**DUSTS**
**Electrostatic Precipitators**
Comparison of electrostatic-precipitator performance with pulse and d-c energization, 12:37668 (R;US)
**Indoor Air Pollution**
Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)
**Lung Clearance**
Comparative simulated lung burdens of dust in rats, guinea pigs, and dogs with chronic inhalation exposures, 12:37963 (RA;US)
Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)
**Retention**
Comparative simulated lung burdens of dust in rats, guinea pigs, and dogs with chronic inhalation exposures, 12:37963 (RA;US)
**Sorptive Properties**
Comparison of indoor dust samples collected in different environments, 12:37618 (RA;US)
**DYES**
**Performance**
Physiological pH fiber-optic chemical sensor based on energy transfer (Eosin and phenol red), 12:37414 (J;US)
**DYMAC SYSTEM**
*See NUCLEAR MATERIALS MANAGEMENT*
*PLUTONIUM*

**DYNAMIC MATERIALS ACCOUNTABILITY SYSTEM**
*See NUCLEAR MATERIALS MANAGEMENT*
*PLUTONIUM*
**DYNAMICS**
**A Codes**
Performance analysis of the two-stage light gas gun, 12:37468 (R;US)
**DYSPROSIUM**
**Metallurgical Effects**
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)
**DYSPROSIUM 152**
**E1-Transitions**
Energy correlations of γ-rays from superdeformed states in Z=66 and 68 isotopes; multipolarities in $^{152}$Dy, 12:38258 (BA;DE)
**E2-Transitions**
Energy correlations of γ-rays from superdeformed states in Z=66 and 68 isotopes; multipolarities in $^{152}$Dy, 12:38258 (BA;DE)
**M1-Transitions**
Energy correlations of γ-rays from superdeformed states in Z=66 and 68 isotopes; multipolarities in $^{152}$Dy, 12:38258 (BA;DE)

## E

**EARTH MAGNETOSPHERE**
*See also MAGNETOTAIL*
*PLASMA SHEET*
**Dynamics**
Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986, 12:38086 (R;US)
**Electrodynamics**
Magnetosphere-ionosphere interaction studies. Final report, 11 July 1980-30 June 1984, 12:38083 (R;US)
**EARTHQUAKES**
**Biological Indicators**
Dating earthquakes along the San Andreas fault system in California, 12:37752 (RA;US)
**Seismic Detection**
Technical report for the period 1 October-31 December 1986, 12:37597 (R;US)
**EBR-2 REACTOR**
**Heat Exchangers**
Validation of an intermediate heat exchanger model for real time analysis, 12:36818 (R;US)
**Loss of Flow**
Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels, 12:36933 (BA;US)
**ECCS**
*See also HIGH PRESSURE COOLANT INJECTION*
**Heat Transfer**
Experience with the revised Appendix K, 12:36839 (RA;US)
**Hydraulics**
Experience with the revised Appendix K, 12:36839 (RA;US)
**Regulations**
Experience with the revised Appendix K, 12:36839 (RA;US)
Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
Revision of the ECCS rule, 12:36837 (RA;US)
**ECR HEATING**
**Wave Propagation**
Polarization change of electron cyclotron waves by reflection, 12:38337 (R;US)
**EDUCATIONAL FACILITIES**
*See also SCHOOL BUILDINGS*
**Energy Conservation**
Institutional Conservation Program evaluation project: Results of higher education survey pretest, 12:37016 (R;US)
**Surveys**
Institutional Conservation Program evaluation project: Results of higher education survey pretest, 12:37016 (R;US)
**EDWIN I. HATCH-2 REACTOR**
*See HATCH-2 REACTOR*
**EFFLUENTS (CHEMICAL)**
*See CHEMICAL EFFLUENTS*
**EFFLUENTS (GASEOUS)**
*See GASEOUS WASTES*
**EFFLUENTS (RADIOACTIVE)**
*See RADIOACTIVE EFFLUENTS*
**EFFUSION**
*See DIFFUSION*
**EIIP**
*See INDUSTRIAL PARKS*
**EINSTEIN GRAVITATION THEORY**
*See GENERAL RELATIVITY THEORY*
**EINSTEIN-DE SITTER MODEL**
*See COSMOLOGICAL MODELS*
**ELECTRIC BATTERIES**
*Devices for production and/or storage of electrical energy from chemical reactions; excludes FUEL CELLS and RADIOISOTOPE BATTERIES.*
Molten salt battery advances, 12:36941 (R;US)
**Aging**
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**Comparative Evaluations**
Batteries for hybrid vehicles or other high-power applications, 12:36947 (J;GB)
**Failures**
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**Mercury**
Review of national emission standards for mercury (final environmental impact statement), 12:37650 (R;US)
**Performance**
Power performance of high-temperature Li-alloy/$FeS_2$ bipolar cells in short pulses, 12:36942 (R;US)
**Recycling**
Code name: Opportunity battery: Phases 1 and 2 of Department of Energy Business Plan, 12:38392 (R;US)
**Research Programs**
Exploratory Battery Technology Development and Testing report for 1985, 12:36944 (R;US)
**Sealing Materials**
Development of CABAL [calcium-boro-aluminate] glasses for use in lithium ambient-temperature batteries, 12:36945 (R;US)
**Seismic Effects**
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)
**ELECTRIC CABLES**
**Dielectric Properties**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Electromagnetic Pulses**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Failure Mode Analysis**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**ELECTRIC CONDENSERS**
*See CAPACITORS*
**ELECTRIC CONDUCTIVITY**
*See also SUPERCONDUCTIVITY*
**Correlations**
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
**ELECTRIC CONTACTS**
**Electrical Properties**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)

**ELECTRIC FILTERS**
**Testing**
The Thermal Flash Protection System, low pass filter JN175666A1, 12:37515 (R;US)
**ELECTRIC GENERATORS**
*Rotating generators only; excludes DIRECT ENERGY CONVERTERS.*
*See also INDUCTION GENERATORS*
**Computerized Simulation**
Improvement in accuracy of prediction of electrical machine constants and generator models for subsynchronous resonance conditions: Volume 3, Development and benefit assessment of finite-element-based saturation model: Final report, 12:36753 (R;US)
**Hydraulic Equipment**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
**Mechanical Transmissions**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
**ELECTRIC HEATING**
**Air Quality**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
**Thermal Comfort**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
**ELECTRIC MOTORS**
**Performance Testing**
Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report, 12:36754 (R;US)
**ELECTRIC POWER**
*See also HYDROELECTRIC POWER*
**Economic Analysis**
Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation, 12:36954 (R;US)
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Marketing**
Proceedings: 1986 Electric Utility Market Research symposium, 12:36995 (R;US)
**Research Programs**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**ELECTRIC POWER INDUSTRY**
**Competition**
Competition: Pressures for change: Final report, 12:36996 (R;US)
**Planning**
Competition: Pressures for change: Final report, 12:36996 (R;US)
**ELECTRIC POWER RESEARCH INSTITUTE**
*See EPRI*
**ELECTRIC POWER SYSTEMS**
*See POWER SYSTEMS*
**ELECTRIC RESISTIVITY**
*See ELECTRIC CONDUCTIVITY*
**ELECTRIC UTILITIES**
**Acid Rain**
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**Economic Analysis**
Effect of conservation programmes on electric utility earnings: results of two case studies, 12:37001 (J;GB)
**Energy Conservation**
Effect of conservation programmes on electric utility earnings: results of two case studies, 12:37001 (J;GB)
**Planning**
Ninth EPRI Member Utility Survey results, 12:36997 (R;US)
**Rate Structure**
The death spiral: An assessment of its likelihood in electric utilities, 12:36993 (R;US)
**Surveys**
Ninth EPRI Member Utility Survey results, 12:36997 (R;US)
**ELECTRICAL CONDUCTIVITY**
*See ELECTRIC CONDUCTIVITY*
**ELECTRICAL INSULATION**
**Physical Radiation Effects**
Field dependence of geminate recombination in a dielectric medium. Final report, October 1974-September 1975, 12:37280 (R;US)
**ELECTRICAL INSULATORS**
**Dielectric Properties**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Electromagnetic Pulses**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Energy Losses**
Energy dissipation in the scanning tunneling microscopy of metals and insulators, 12:37276 (BA;US)
**Failure Mode Analysis**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Tunnel Effect**
Tunneling from a self-energy approach, 12:37277 (BA;US)
**ELECTRICAL RESISTANCE**
*See ELECTRIC CONDUCTIVITY*
**ELECTRICAL RESISTIVITY**
*See ELECTRIC CONDUCTIVITY*
**ELECTRIC-POWERED VEHICLES**
**Electric Batteries**
Batteries for hybrid vehicles or other high-power applications, 12:36947 (J;GB)
Zinc-bromine battery development, 12:36946 (R;US)
**ELECTROCHEMICAL CELLS**
*See also ELECTRIC BATTERIES*
*FUEL CELLS*
*PHOTOELECTROCHEMICAL CELLS*
**Control Systems**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)
**Performance**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**Thermodynamics**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**ELECTROCHROMISM**
**Research Programs**
Recent results: SERI's development of advanced glazings, 12:37054 (RA;US)
**ELECTRODES**
**Fabrication**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
**Geometry**
Particle compaction with alternating electric fields: The effects of electrode geometry, 12:37428 (BA;US)

**Materials**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
**ELECTROLYSIS**
**Parametric Analysis**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**ELECTROLYTES**
**Electric Impedance**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**Fabrication**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
**Materials**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
**Reflectivity**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**ELECTROLYTIC CELLS**
Thermoelectric conversion with ion conductors. Quarterly technical progress report No. 2, 1 November 1986-15 January 1987, 12:37007 (R;US)
**Electric Potential**
Absolute half-cell potential: A simple direct measurement, 12:37431 (J;US)
**Membranes**
Optimisation of a membrane cell cascade for chlorine alkali electrolysis under the aspect of energy consumption, 12:37405 (R;DE;In German)
**Performance Testing**
Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**Pilot Plants**
Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**ELECTROMAGNETIC FIELDS**
**Computerized Simulation**
Computation of fields and signals due to ferromagnetic anomalies, 12:37268 (BA;US)
**ELECTROMAGNETISM**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**ELECTRON ANTINEUTRINOS**
**Mass**
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)
**Rest Mass**
Limit on the anti $\nu$ mass in free molecular tritium beta decay, 12:38152 (BA;DE)
**ELECTRON BEAMS**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**Beam Currents**
Free-electron laser success explained, 12:37492 (J;US)
**Brightness**
Free-electron laser success explained, 12:37492 (J;US)
**Spin Orientation**
Measurement of electron beam polarization at the SLC, 12:37564 (R;US)
**ELECTRON CYCLOTRON-RESONANCE HEATING**
*See ECR HEATING*
**ELECTRON MICROSCOPES**
**Friction**
A device to measure friction coefficients and contact resistance inside a scanning Auger microscope, 12:37578 (R;US)
**ELECTRON MICROSCOPY**
*See also TRANSMISSION ELECTRON MICROSCOPY*
**Diffraction**
Diffraction effects from interfaces, 12:37211 (R;US)
**ELECTRON NEUTRINOS**
*See also ELECTRON ANTINEUTRINOS*
**Mass**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**Neutrino Oscillation**
Comparison of narrow-band and wide-band neutrino beams in the search for $\nu$/sub $\mu$/$\rightarrow\nu$/sub e/ oscillations, 12:38150 (J;US)
**ELECTRON PAIRS**
**Pair Production**
Calculation of pair production by 10 and 20 MeV photons, 12:38275 (J;US)
**ELECTRON REACTIONS**
**Deep Inelastic Scattering**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Elastic Scattering**
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Historical Aspects**
35 years of electron scattering, 12:38271 (R;US)
**Inelastic Scattering**
Electroexcitation of discrete levels in /sup 12/C and /sup 13/C at high momentum transfers, 12:38240 (J;US)
Semi-inclusive inelastic electron scattering from nuclei, 12:38265 (R;US)
**P Invariance**
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)
**Particle Production**
Recent axion searches, 12:38142 (RA;US)
**Quark Model**
Influence of six-quark bags on electron scattering, 12:38268 (R;US)
**ELECTRONIC CIRCUITS**
**Design**
Some applications of phasor measurements to adaptive protection, 12:37511 (R;US)
**Temperature Noise**
Thermal noise in linear passive multiports, 12:37512 (R;US)
**ELECTRONIC EQUIPMENT**
*See also MICROWAVE EQUIPMENT*
*POWER SUPPLIES*
**Superconducting Junctions**
SIS (superconductor-insulator-superconductor) mixer research. Final report, 15 November 1985-14 November 1986, 12:37452 (R;US)
**ELECTRONICS (QUANTUM)**
*See QUANTUM ELECTRONICS*
**ELECTRON-NUCLEON INTERACTIONS**
**Degrees of Freedom**
Spin degrees of freedom in electron nucleon scattering in the resonance region, 12:38124 (R;US)
**Resonance Scattering**
Spin degrees of freedom in electron nucleon scattering in the resonance region, 12:38124 (R;US)
**ELECTRON-POSITRON INTERACTIONS**
Future frontiers for $e^+e^-$ collisions: physics of SLC and LEP, 12:38145 (R;US)
**Annihilation**
$E^+e^-\rightarrow W^+W^-$ in $E_6$ models with additional neutral gauge bosons, 12:38199 (J;US)
Excited lepton search, 12:38116 (R;DE)
Radiative tau pair production and search for new particles decaying into tau, 12:38117 (R;DE)
**Inelastic Scattering**
Excited lepton search, 12:38116 (R;DE)
**Multiple Production**
Comparison of multihadronic event generators, 12:38186 (RA;US)
Physics from PEP, 12:38134 (RA;US)

Results from PETRA, 12:38135 (RA;US)
**Pair Production**
Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories, 12:38164 (R;US)
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Status of Monte Carlos for a tau pair production at SLC, 12:38170 (RA;US)
**Particle Production**
Bound on the number of neutrinos from $e^+e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA, 12:38128 (RA;US)
Counting neutrinos at SLC, 12:38189 (RA;US)
Finding open top, 12:38176 (RA;US)
Forward-backward asymmetry for b and c quarks, 12:38172 (RA;US)
Granlibakken meeting: b and c quark summary, 12:38187 (RA;US)
Higgs boson production at the $Z^0$ and the possibilities of vertex detectors, 12:38183 (RA;US)
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
Monte Carlo models for top production, 12:38175 (RA;US)
New stable charged particles, 12:38181 (RA;US)
Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)
Physics from PEP, 12:38134 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Recent results from the crystal ball experiment, 12:38138 (RA;US)
Reconstructing heavy long-lived neutral leptons, 12:38180 (RA;US)
Renormalization of electroweak interactions and the BREMMUS Monte Carlo simulator, 12:38167 (RA;US)
Renormalization group improved Yennie-Frautschi-Suura Theory and Monte Carlo event generators, 12:38169 (RA;US)
Report on electroweak parameters, 12:38171 (RA;US)
Results from PETRA, 12:38135 (RA;US)
Search for new interactions via lepton flavor violation at or beyond the $Z^0$ pole., 12:38174 (RA;US)
Small visible energy events and close-mass lepton pairs, 12:38178 (RA;US)
Status report on the polarization facility at the SLC, 12:38173 (RA;US)
Study of $D^+ \rightarrow K^-\pi^+\pi^+$ selection using the vertex drift chamber, 12:38188 (RA;US)
Study of QED radiative corrections at the Z, 12:38168 (RA;US)
Summary of work on $Z^0 \rightarrow$ Higgs neutrinos antineutrinos, 12:38182 (RA;US)
Summary of work on $Z^0 \rightarrow$ Higgs anti ff, 12:38184 (RA;US)
Summary of work on QCD backgrounds to $Z^0 \rightarrow H^0$ anti ell ell, 12:38185 (RA;US)
Supersymmetric particle searches, 12:38177 (RA;US)
Toponium physics with a small data sample, 12:38179 (RA;US)
Toponium-$Z^0$ mixing, 12:38192 (RA;US)
**Reviews**
The future of electron-positron colliders, 12:37535 (BA;US)
**ELECTROPRODUCTION**
Semi-inclusive inelastic electron scattering from nuclei, 12:38265 (R;US)
**ELECTROSLAG CASTING**
**Performance Testing**
Electroslag component casting, 12:36250 (RA;US)
**ELECTROSTATIC PRECIPITATORS**
**Air Pollution Abatement**
Comparison of electrostatic-precipitator performance with pulse and d-c energization, 12:37668 (R;US)
**Efficiency**
Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985, 12:37652 (R;US)
**Maintenance**
Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report, 12:37610 (R;US)
**Operation**
Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report, 12:37609 (R;US)
Electrostatic precipitator guidelines: Volume 3, Troubleshooting: Final report, 12:37610 (R;US)
**ELECTROSTATIC WAVES**
*See PLASMA WAVES*
**ELECTROSTATICS**
**Comparative Evaluations**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
**ELECTROWEAK MIXING ANGLE**
*See WEINBERG ANGLE*
**ELECTROWEAK MODEL**
*See WEINBERG-SALAM GAUGE MODEL*
**ELEMENTS**
*For chemical elements only.*
*See also METALS*
*TRANSURANIUM ELEMENTS*
**Biological Accumulation**
History of the chemical environment from elemental analysis of tree rings, 12:37956 (RA;US)
**Environmental Transport**
History of the chemical environment from elemental analysis of tree rings, 12:37956 (RA;US)
**EMBRITTLEMENT**
**Data Base Management**
Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
**EMBRYOS**
**Freezing**
Stopping biological time: The freezing of living cells, 12:37936 (R;US)
**EMC EFFECT**
The EMC effect and related issues, 12:38269 (R;US)
**EMERGENCIES**
*See ACCIDENTS*
**EMERGENCY CORE COOLING SYSTEM**
*See ECCS*
**EMERGENCY PLANS**
**Cost Benefit Analysis**
Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)
**Human Factors**
Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)
**EMERGENCY PROVISIONS**
*See EMERGENCY PLANS*
**EMISSION SPECTROSCOPY**
*See also FLUORESCENCE SPECTROSCOPY*
**Performance Testing**
Development of inductively coupled plasma spectroscopy for on-line analysis, 12:36300 (RA;US)
**EMPLOYEES**
*See PERSONNEL*
**EMULSIONS**
*See also MICROEMULSIONS*
**Performance**
Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)
**END USE SECTOR**
*See INDUSTRY*
*RESIDENTIAL SECTOR*
*TRANSPORTATION SECTOR*
**ENDOTOXINS**
**Toxicity**
Acute effects of neutrophils on nasal epithelial mucosubstances: quantitative histochemistry, 12:37984 (RA;US)
Biochemical and cellular changes in nasal lavages after intranasal instillation of endotoxin, 12:37983 (RA;US)
**ENERGY ANALYSIS**
**Research Programs**
Energy Division annual progress report for period ending September 30, 1986, 12:36750 (R;US)
**ENERGY CONSERVATION**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)

**Economics**
Analyzing energy conservation retrofits in public housing: savings, cost-effectiveness, and policy implications, 12:37040 (RA;US)
**Market**
Technology diffusion of energy-related products in residential markets, 12:37081 (R;US)
**Surveys**
Institutional Conservation Program evaluation project: Results of higher education survey pretest, 12:37016 (R;US)
Institutional Conservation Program Evaluation Project: Results of hospital survey pretest, 12:37017 (R;US)
**Values**
The value of conservation in the Pacific Northwest, 12:37014 (R;US)

**ENERGY CONSUMPTION**
*See also FUEL CONSUMPTION*
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Calculation Methods**
Calculated and measured energy consumption for low energy houses, 12:37038 (RA;US)
**Data Compilation**
Monthly energy review, March 1987, 12:36977 (R;US)
**Load Analysis**
End use loads in multifamily buildings: some preliminary findings, 12:37036 (RA;US)

**ENERGY DEMAND**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)

**ENERGY EFFICIENCY**
**Data Analysis**
Cross-comparisons of new energy-efficient houses, 12:37031 (RA;US)
**Demonstration Programs**
Options for reducing energy use in manufactured housing, 12:37032 (RA;US)
**Economics**
Energy savings in 12 multifamily buildings retrofitted under a shared savings program, 12:37051 (RA;US)
**Marketing**
Options for reducing energy use in manufactured housing, 12:37032 (RA;US)
**Performance Testing**
Cross-comparisons of new energy-efficient houses, 12:37031 (RA;US)
**Standards**
Heating cost allocation in centrally heated rental housing: energy conservation potential and standards issues, 12:37042 (RA;US)

**ENERGY EXPENSES**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Calculation Methods**
Development of a computerized multifamily audit: technical and implementation issues, 12:37037 (RA;US)
**Comparative Evaluations**
Thermal and cost comparison of six superinsulated houses and one passive solar house in the Idaho residential demonstration program, 12:37045 (RA;US)

**ENERGY INTEGRATED INDUSTRIAL PARKS**
*See INDUSTRIAL PARKS*

**ENERGY MANAGEMENT**
Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)
**Regional Analysis**
Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)

**ENERGY MODELS**
**Computer Graphics**
An assessment of the graphics upgrade needs of technology policy: Office of Policy, Planning and Analysis, 12:38407 (R;US)

**ENERGY POLICY**
**Political Aspects**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**Regional Analysis**
Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)

**ENERGY RECOVERY**
*See also HEAT RECOVERY*
**Optimization**
Petroleum taxes and optimal resource recovery, 12:36414 (R;NO)

**ENERGY SOURCE DEVELOPMENT**
**Socio-Economic Factors**
Four futures: energy implications of social and economic change, 12:36952 (R;NZ)
**Technology Assessment**
Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment), 12:36974 (R;US)

**ENERGY SOURCES**
*See also FOSSIL FUELS*
*RENEWABLE ENERGY SOURCES*
*WOOD FUELS*
**Data Compilation**
Monthly energy review, March 1987, 12:36977 (R;US)
**Exports**
Soviet energy exports to world markets, 12:36990 (RA;SE)
**Meetings**
Soviet energy. Proceedings from an international seminar, 12:36987 (R;SE)
**Trade**
Conclusions from the seminar, 12:36988 (RA;SE)
Energy trade within Comecon, 12:36989 (RA;SE)

**ENERGY STORAGE SYSTEMS**
**Systems Analysis**
Applications of energy storage systems in lifting gears, 12:36936 (R;DE;In German)

**ENERGY SUPPLIES**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Political Aspects**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**Regional Analysis**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**Sweden**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)

**ENERGY SYSTEMS**
*Use only in generic sense; e.g., comparisons of several energy systems or theoretical studies when system is not denoted specifically.*
*See also BINARY-FLUID SYSTEMS*
*COOLING SYSTEMS*
*ENERGY STORAGE SYSTEMS*
*HEAT DISTRIBUTION SYSTEMS*
*HEATING SYSTEMS*
*NATURAL GAS DISTRIBUTION SYSTEMS*
*POWER SYSTEMS*
*SPACE HVAC SYSTEMS*
*STEAM SYSTEMS*
**Heat Pumps**
Alternative energy supply systems for lettuce production in greenhouses, 12:37145 (R;NO;In Norwegian)
**Planning**
Energy statistics and the planning perspective, 12:36979 (J;GB)
**Statistics**
Energy statistics and the planning perspective, 12:36979 (J;GB)

**ENGINEERED SAFETY SYSTEMS**
*See also CONTAINMENT SYSTEMS*
*ECCS*
**Electric Batteries**
Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)

**ENGINEERING TEST REACTOR**
*See ETR REACTOR*
**ENGLAND**
*See UNITED KINGDOM*
**ENHANCED RECOVERY**
*See also THERMAL RECOVERY*
**Computerized Simulation**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**Image Scanners**
Gamma tomography as an aid to experimental enhanced oil recovery, 12:36369 (R;GB)
**Optimization**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**ENRICHMENT**
*For isotopic enrichment use ISOTOPE SEPARATION.*
**Environmental Impacts**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**ENRICHMENT PLANTS (CENTRIFUGE)**
*See CENTRIFUGE ENRICHMENT PLANTS*
**ENTHALPY**
**Calculation Methods**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)
**ENTOMOLOGY**
*See INSECTS*
**ENTRY CONTROL SYSTEMS**
**Identification Systems**
A performance evaluation of personnel identity verifiers, 12:36567 (R;US)
**Recommendations**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)
**Reliability**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)
**ENVELOPE HOUSES**
*See DOUBLE ENVELOPE BUILDINGS*
**ENVIRONMENT**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)
**Bibliographies**
Biomedical and Environmental Sciences Programs: Publications 1986, 12:37859 (R;US)
**Management**
Executive summary of long-range environmental management plans: FY 1987-1993, 12:36960 (R;US)
**Pollution Regulations**
Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
**Variations**
Disaggregation of tree-ring series for environmental studies, 12:37758 (RA;US)
Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies, 12:37762 (RA;US)
**ENVIRONMENTAL ENGINEERING**
Reference guide for building diagnostics equipment and techniques. Final report, August 1982-July 1986, 12:37015 (R;US)
**ENVIRONMENTAL PARKS**
*See NATURE RESERVES*
**ENVIRONMENTAL POLICY**
**Bibliographies**
Publications on environmental policy in Japan, 12:36961 (R;DE;In German)
**Compliance**
Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
**Recommendations**
Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
**ENVIRONMENTAL PROTECTION AGENCY**
*See US EPA*
**ENVIRONMENTAL QUALITY**
*See also AIR QUALITY*
*WATER QUALITY*
**Bibliographies**
EPA (Environmental Protection Agency) Publications Bibliography. Quarterly abstract bulletin. Quarterly report, 12:36968 (R;US)
**Indicators**
Environmental indicators: a comparison of international trends, 12:37857 (R;IT;In Italian)
**ENVIRONMENTAL TEMPERATURE**
*See AMBIENT TEMPERATURE*
**ENVIRONMENTAL TRANSPORT**
*See also RADIONUCLIDE MIGRATION*
**Mathematical Models**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)
Transport of organic contaminants in coastal plain sediments, 12:37808 (R;US)
**ENZYMES**
*The enzyme code numbers from ENZYME NOMENCLATURE: RECOMMENDATIONS (1972) OF THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY AND THE INTERNATIONAL UNION OF BIOCHEMISTRY is given in a Scope Note for the individual enzymes.*
*See also DNA HELICASES*
*HYDROLASES*
*LIGASES*
*OXIDOREDUCTASES*
*TRANSFERASES*
**Crystal Structure**
Structure of yeast inorganic pyrophosphastase: A progress report, 12:37861 (R;US)
**EOR**
*See ENHANCED RECOVERY*
**EPA**
*See US EPA*
**EPITHELIUM**
**DNA Replication**
Effect of irradiation on unscheduled DNA synthesis induced by 4-nitroquinoline in tracheal epithelium of rats, 12:37929 (RA;US)
**Inflammation**
Acute effects of neutrophils on nasal epithelial mucosubstances: quantitative histochemistry, 12:37984 (RA;US)
**EPOXIDES**
**Aerosols**
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)
**Mechanical Properties**
Mechanical and thermal characterization of unidirectional aramid/epoxy. Final report, November 1985-December 1986, 12:37329 (R;US)
**Tensile Properties**
Baseline tensile tests of composite materials for LDEF (Long duration exposure facility) exposure, 12:37342 (R;US)
**EPOXY COMPOUNDS**
*See EPOXIDES*
**EPRI**
**Research Programs**
Nuclear safety—forward on technology and backward on perception, 12:36889 (RA;US)
**ERBIUM 149**
**Energy Levels**
Observation of /sup 149/Tm decay to /sup 149/Er levels and $\beta$-delayed proton emission, 12:38253 (J;US)
**ESCHERICHIA COLI**
**Genetic Engineering**
Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli, 12:37870 (J;US)

**Genetic Mapping**
Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli, 12:37870 (J;US)

**ESTERS**
*Includes esters of organic and inorganic acids.*
**Chemical Preparation**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)
**Structural Chemical Analysis**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)

**ESTUARIES**
**Turbidity**
Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK , 12:36733 (R;GB)
**United Kingdom**
Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK , 12:36733 (R;GB)

**ESTUARINE ECOSYSTEMS**
*See AQUATIC ECOSYSTEMS*

**ETA MESONS**
**Particle Production**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**Radiative Decay**
Recent results from the crystal ball experiment, 12:38138 (RA;US)

**ETA-549**
*See ETA MESONS*

**ETHANE**
**Chemical Reaction Yield**
Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory, 12:37387 (R;US)
**Fischer-Tropsch Synthesis**
Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling, 12:36595 (B;US)
**Ion-Molecule Collisions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)

**1,2-ETHANEDIOL**
*See GLYCOLS*

**ETHANOL**
**Biosynthesis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**Production**
Controlling of processes for producing energy carriers by means of biotechnique, 12:36602 (R;SE;In Swedish)
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**Yields**
Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi, 12:36604 (J;US)

**ETHANOL FUELS**
*Use for pure ethanol, ethanol-water mixtures, or ethanol with additives; for ethanol-gasoline mixtures, use GASOHOL.*
**Economics**
Ethanol production from agricultural raw materials, 12:36992 (R;IT;In Italian)
**Marketing Research**
Ethanol production from agricultural raw materials, 12:36992 (R;IT;In Italian)

**ETHNIC GROUPS**
*See MINORITY GROUPS*

**ETHOCEL**
*See CELLULOSE*

**ETHYL ALCOHOL**
*See ETHANOL*

**ETHYLENE**
**Hydrogenation**
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)

**ETHYLENE GLYCOL**
*See GLYCOLS*

**ETHYLENE POLYMERS**
*See POLYETHYLENES*

**ETR REACTOR**
*EGandG Idaho, Inc., Idaho Falls, Idaho*
**Research Programs**
Ignition physics study group support of the engineering test reactor program, 12:38375 (R;US)

**EUPHORBIA**
**Cultivation**
Quality and quantity of latex which can be produced from natural vegetation in Greece, 12:36630 (R;FR)

**EUROPE**
*See also WESTERN EUROPE*
**Solar Energy**
Solar energy: European research and development. Contractors' catalogue 1984, 12:36619 (R;XE)

**EUROPEAN MUON COLLABORATION EFFECT**
*See EMC EFFECT*

**EUROPIUM NITRATES**
**Density**
Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C, 12:37423 (J;US)
**Osmosis**
Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C, 12:37423 (J;US)

**EVACUATED COLLECTORS**
*See also EVACUATED TUBE COLLECTORS*
**Performance**
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)

**EVACUATED TUBE COLLECTORS**
**Performance Testing**
Characterization of evacuated collectors, arrays, and collection subsystems: A report of Task 6: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36703 (R;FR)
**Thermal Efficiency**
Characterization of evacuated collectors, arrays, and collection subsystems: A report of Task 6: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36703 (R;FR)

**EVACUATION**
**Risk Assessment**
Evaluation of protective action risks, 12:36554 (R;US)

**EVALUATION**
**Computer Codes**
Technical/economic analyses of mine-to-market scenarios involving varying levels of coal preparation and coal water slurry production using a computerized coal evaluation model: Final report (Report includes program on a disk in pocket), 12:36364 (R;US)

**EVAPORATORS**
**Design**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Field Tests**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Heat Transfer**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)

**Waste Product Utilization**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**EVEN-EVEN NUCLEI**
*Even protons, even neutrons.*
*See also CALIFORNIUM 252*
*CARBON 12*
*CERIUM 144*
*CURIUM 244*
*DYSPROSIUM 152*
*GADOLINIUM 152*
*GADOLINIUM 154*
*GERMANIUM 76*
*LEAD 208*
*LEAD 210*
*LEAD 212*
*OSMIUM 190*
*OSMIUM 192*
*OXYGEN 18*
*PLUTONIUM 238*
*PLUTONIUM 244*
*RADIUM 226*
*RADIUM 228*
*RADON 220*
*SELENIUM 82*
*STRONTIUM 90*
*URANIUM 234*
**Nuclear Deformation**
Global set of quadrupole deformation parameters for even-even nuclei, 12:38279 (BA;DE)
**EXCHANGE (HEAT)**
*See HEAT TRANSFER*
**EXCRETION ANALYSIS**
*See PERSONNEL MONITORING*
**EXHAUST GASES**
**Air Pollution**
Passenger-car emissions in the speed range 80-120 kmph. Traffic measurements on a fleet of cars in the Pfaender Road Tunnel, 12:37183 (R;XE;In German)
Sources and evaluation of uncertainty in long-range transport models, 12:37691 (R;US)
**Carbon Monoxide**
User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)
**Carcinogens**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Hydrocarbons**
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**Mutagens**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Particulates**
Control of atmospheric fine primary carbon particle concentrations. Final report, 12:37654 (R;US)
**Photochemical Reactions**
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
**Soot**
Parametric investigation of soot behavior and other emissions in a gas-turbine combustor. Master's thesis, 12:36461 (R;US)
**Toxicity**
Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)
**EXPERIMENTAL BREEDER REACTOR-2**
*See EBR-2 REACTOR*
**EXPERIMENTAL FACILITIES (ACCELERATOR)**
*See ACCELERATOR FACILITIES*
**EXPLORATION**
*See also GEOTHERMAL EXPLORATION*
**Cost**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**EXPLOSIVES**
*See also CHEMICAL EXPLOSIVES*
**Hazardous Materials**
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)
**EXPOSURE (RADIATION DOSES)**
*See RADIATION DOSES*
**EXTRACTION APPARATUSES**
*See also MIXER-SETTLERS*
**Mathematical Models**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-β-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Performance**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-β-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**EXTRUSION**
**Lubricants**
Lubication and surface finish of extruded aluminum, 12:37218 (R;US)

## F

**F CODES**
A high gain free electron laser amplifier design for the Alcator-C tokamak (FRED), 12:37518 (R;US)
**F MESONS**
*Prior to Jan. 1985 this information was indexed with the descriptor F-2030 RESONANCES.*
**Particle Production**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**Radiative Decay**
Anomalies in radiation decays of charmed mesons, 12:38208 (TG;DE)
**Weak Hadronic Decay**
Results from PETRA, 12:38135 (RA;US)
**F-2030 RESONANCES**
*See F MESONS*
**FACILITIES (ACCELERATOR)**
*See ACCELERATOR FACILITIES*
**FACILITIES (EDUCATIONAL)**
*See EDUCATIONAL FACILITIES*
**FACILITIES (MAINTENANCE)**
*See MAINTENANCE FACILITIES*
**FACILITIES (MILITARY)**
*See MILITARY FACILITIES*
**FACILITIES (NUCLEAR)**
*See NUCLEAR FACILITIES*
**FACILITIES (STORAGE)**
*See STORAGE FACILITIES*
**FACILITIES (TEST)**
*See TEST FACILITIES*
**FAEROE ISLANDS**
**Tidal Power Plants**
Proposal of a floating tide power plant in Vestmannasund, 12:36734 (R;DK;In Danish)
**FALLOUT**
*For radioactive fallout only.*
**Particle Size**
Particle-size determination from local fallout. Master's thesis, 12:37587 (R;US)
**Radiation Dose Distributions**
Computer fallout code using variable winds for operational-type studies. Master's thesis, 12:37586 (R;US)
**FALLOUT PARTICULATES**
*See FALLOUT PARTICLES*
**FARADAY GENERATORS**
*See MHD GENERATORS*

**FARM EQUIPMENT**
**Energy Conservation**
Energy saving by means of mutual adjustment of tractor and tools size, 12:37149 (R;DK;In Danish)
**Fuel Economy**
Energy saving by means of mutual adjustment of tractor and tools size, 12:37149 (R;DK;In Danish)
**FAROE ISLANDS**
*See FAEROE ISLANDS*
**FAST BREEDER TYPE REACTORS**
*See FBR TYPE REACTORS*
**FAST FLUX TEST FACILITY REACTOR**
*See FFTF REACTOR*
**FASTENERS**
**Inspection**
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Seismic Effects**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**FAST-MIXED SPECTRUM REACTOR**
*See FBR TYPE REACTORS*
**FATIGUE**
**Evaluation**
Elastic creep-fatigue evaluation for ASME [American Society of Mechanical Engineers] code, 12:37505 (R;US)
**FATTY ACIDS**
*See CARBOXYLIC ACIDS*
**FAULT TOLERANT COMPUTERS**
Effects of message loss on distributed termination. Technical report, 12:38417 (R;US)
**FAULT TREE ANALYSIS**
**Expert Systems**
The application of expert systems to the analysis of logic trees, 12:38016 (R;US)
**FAULT TREE SYSTEMS**
*See FAULT TREE ANALYSIS*
**FBR TYPE REACTORS**
*See also LMFBR TYPE REACTORS*
*PFR REACTOR*
**Mixed Oxide Fuels**
Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
**FEDERAL BUILDINGS**
**Hazardous Materials**
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma (PCBs), 12:37675 (R;US)
**FEDERAL DRIVING CYCLE**
*See FEDERAL TEST PROCEDURE*
**FEDERAL REGION I**
*Prior to June 1982 this concept was indexed to NORTH ATLANTIC REGION.*
**Air Quality**
Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)
**Coastal Waters**
Shelf Edge Exchange Processes: Phase 1 (SEEP-1), Hydrography report, July 1983-October 1984, 12:38049 (R;US)
**FEDERAL REPUBLIC OF GERMANY**
**Air Pollution Abatement**
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
**Forests**
Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo, 12:37671 (R;US)
**PWR Type Reactors**
Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
**Radioactive Waste Disposal**
Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
**Test Facilities**
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
**FEDERAL TEST PROCEDURE**
Application for certification 1987 model year heavy-duty engines, 12:37168 (R;US)
Application for certification 1987 model year heavy-duty engines - Caterpillar, 12:37169 (R;US)
Application for certification 1987 model year heavy-duty engines - Chrysler, 12:37170 (R;US)
Application for certification 1987 model year heavy-duty engines - Mitsubishi Motors corporation, 12:37171 (R;JP)
Application for certification 1987 model year light-duty vehicles, 12:37172 (R;US)
Application for certification 1987 model year light-duty vehicles - Chrysler, 12:37173 (R;US)
Application for certification 1987 model year light-duty vehicles and light-duty trucks - Ford Motor Company, 12:37174 (R;US)
Application for certification 1987 model year light-duty vehicles - General Motors, 12:37175 (R;US)
Application for certification 1987 model year light-duty vehicles - Mercedes-Benz, 12:37176 (R;US)
Application for certification 1987 model year light-duty vehicles - Nissan, 12:37177 (R;JP)
Application for certification 1987 model year light-duty vehicles - American Motors Corporation (Renault), 12:37178 (R;US)
Application for certification 1987 model year light-duty vehicles - Rolls Royce, 12:37179 (R;US)
Application for certification 1987 model year light-duty vehicles - Volkswagen, 12:37180 (R;US)
Application for certification 1987 model year light-duty vehicles, 12:37181 (R;US)
Application for certification 1987 model year light-duty vehicles - Isuzu, 12:37182 (R;US)
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**FEDERAL WATER POLLUTION CONTROL ACT**
*See CLEAN WATER ACT*
**FEED MATERIALS PLANTS**
**Environmental Impact Statements**
Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming, 12:36547 (R;US)
**Remedial Action**
Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado: Volume 1, Text, 12:36548 (R;US)
**FERMENTATION**
**Process Control**
Controlling of processes for producing energy carriers by means of biotechnique, 12:36602 (R;SE;In Swedish)
**FERMENTATION ALCOHOL**
*See ETHANOL*
**FERMILAB TEVATRON**
**Planning**
1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components, 12:37538 (BA;US)
**FERMIONS**
*See also LEPTONS*
**Particle Production**
Renormalization of electroweak interactions and the BREMMUS Monte Carlo simulator, 12:38167 (RA;US)
**FERRITES**
*Specific compounds should be indexed by coordination of a descriptor of the form (CATION) COMPOUNDS and the above anion descriptor.*
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)

**FERROELECTRIC MATERIALS**
**Electronic Circuits**
A circuit for characterization of ferroelectrics, 12:37510 (R;IN)
**Hysteresis**
A circuit for characterization of ferroelectrics, 12:37510 (R;IN)
**FERROMAGNETIC MATERIALS**
**Acoustic Emission Testing**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**Electromagnetic Testing**
Computation of fields and signals due to ferromagnetic anomalies, 12:37268 (BA;US)
**Grain Size**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**Magnetic Testing**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**FFTF REACTOR**
*Westinghouse Hanford Company, Richland, Washington*
**C Codes**
CLEO: A knowledge-based refueling assistant at FFTF, 12:36815 (R;US)
**Fuel Pins**
Transient survivability of LMR oxide fuel pins, 12:36820 (R;US)
**Reactor Fueling**
CLEO: A knowledge-based refueling assistant at FFTF, 12:36815 (R;US)
**FIBER OPTICS**
**Performance**
Physiological pH fiber-optic chemical sensor based on energy transfer (Eosin and phenol red), 12:37414 (J;US)
**Research Programs**
Fiber optic instrumentation development, 12:36305 (RA;US)
**FIBROBLASTS**
**Cell Proliferation**
Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts, 12:37971 (RA;US)
**Immunology**
Epidermal growth factor-nonresponsive 3T3 variants do not contain epidermal growth factor receptor-related antigens or mRNA, 12:37880 (J;US)
**FIELD-REVERSED MIRROR REACTORS**
**Magnetic Fields**
Field-reversed configuration formation and confinement studies on the LSM device, 12:38341 (R;US)
**Plasma Confinement**
Field-reversed configuration formation and confinement studies on the LSM device, 12:38341 (R;US)
**FIELDS (ELECTROMAGNETIC)**
*See ELECTROMAGNETIC FIELDS*
**FIELDS (MAGNETIC)**
*See MAGNETIC FIELDS*
**FILTERS**
*See also ELECTRIC FILTERS*
*OPTICAL FILTERS*
**Materials Recovery**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**FILTERS (ELECTRIC)**
*See ELECTRIC FILTERS*
**FINGERPRINTING (OIL SPILLS)**
*See OIL SPILLS*
**FINITE DIFFERENCE METHOD**
Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure, 12:36492 (R;US)
**FINITE ELEMENT METHOD**
**Computer Codes**
Coupling boundary integral and finite element formulations for nonlinear halfspace problems, 12:38412 (R;US)
**FIRE FIGHTING**
**Health Hazards**
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
**FIRE HAZARDS**
**Data Compilation**
Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review, 12:36923 (R;US)
**FIRE STATIONS**
*See PUBLIC BUILDINGS*
**FIREDAMP**
*See METHANE*
**FIRES**
**Air Pollution**
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
**Computerized Simulation**
Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)
**Environmental Effects**
Factors affecting the growth response of ponderosa pine to prescribed burning, 12:37756 (RA;US)
Fire and stand histories in subalpine forests on the Thredbo ski slopes, Koscuisko, National Park, NSW, Australia, 12:37747 (RA;US)
Fire frequency and old trees in the Southern Canadian Rockies, 12:37748 (RA;US)
Fire history of lodgepole pine of Mt. San Jacinto, California, 12:37746 (RA;US)
**Heat Transfer**
Heat transfer to large objects in large pool fires, 12:37464 (R;US)
**FIREWOOD**
*See WOOD FUELS*
**FIRS**
**Biological Stress**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Development of old-growth Douglas-fir forests northeast of Mount St. Helens, Washington, following an A.D. 1480 eruption, 12:37750 (RA;US)
**Plant Growth**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Development of old-growth Douglas-fir forests northeast of Mount St. Helens, Washington, following an A.D. 1480 eruption, 12:37750 (RA;US)
Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide, 12:37953 (RA;US)
Western spruce budworm outbreaks in northern New Mexico: tree-ring evidence of occurrence and radial growth impacts from 1700 to 1983, 12:37883 (RA;US)
**FISCHER-TROPSCH SYNTHESIS**
**Catalysts**
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 6 for the period 1 January to 31 March 1987, 12:36584 (R;US)
Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling, 12:36595 (B;US)
Slurry-phase Fischer-Tropsch synthesis, 12:36581 (R;US)
**FISHES**
**Ecology**
Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout (Cynoscion arenarius; Cynoscion nothus), 12:37836 (R;US)

**Injuries**
Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington, 12:37847 (J;US)
**Liver Cells**
Effects of environmental factors (food, heavy metals) on teleostean hepatocytes, 12:37986 (R;DE;In German)
**Pollution**
Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir, 12:37846 (R;US)
**Population Dynamics**
Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)
**Radionuclide Kinetics**
Concentrations of radionuclides in fish collected from Bikini Atoll between 1977 and 1984, 12:37852 (R;US)
**FISSIONABLE MATERIALS MANAGEMENT**
*See NUCLEAR MATERIALS MANAGEMENT*
**FISSURED FORMATIONS**
*See FRACTURED RESERVOIRS*
**FIXED BED**
*See PACKED BED*
**FLAME PROPAGATION**
**Mathematical Models**
Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)
**FLAME SPECTROMETRY**
*See EMISSION SPECTROSCOPY*
**FLAMES**
**Raman Spectroscopy**
Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)
**Temperature Measurement**
Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)
**FLASKS**
*See CASKS*
**FLAT PLATE COLLECTORS**
*See also TRICKLE-TYPE COLLECTORS*
**Antireflection Coatings**
Sol-gel AR films for solar applications, 12:37369 (BA;US)
**Performance**
Consideration of the heat-removal factor for liquid-cooled flat-plate solar collectors, 12:36709 (J;GB)
**FLAWS**
*See DEFECTS*
**FLOODS**
**Annual Variations**
Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)
**Biological Indicators**
Potential for use of cottonwoods as indicators of past floods, 12:37831 (RA;US)
**Environmental Effects**
Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)
**Seasonal Variations**
Variations of the standard error/mean index ratio on wetland sites (Taxodium distichum), 12:37763 (RA;US)
**FLORIDA**
**Military Facilities**
Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)
**Phosphate Minerals**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**Wetlands**
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**FLOTATION**
Development and demonstration of a static tube flotation system for producing superclean coal: Technical progress report, 7th quarterly ending 6/30/87 (2 stages), 12:36236 (R;US)
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**Comparative Evaluations**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
**Correlations**
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
**Reagents**
Surface chemical problems in coal flotation, 12:36234 (R;US)
**Specificity**
Surface chemical problems in coal flotation, 12:36234 (R;US)
**FLOW MODELS**
**Meetings**
SIAM 1986 national meeting: Final technical report, 12:38102 (R;US)
**Numerical Solution**
Numerical solution of the Hele-Shaw equations, 12:38103 (R;US)
**FLOW RATE**
**Optimization**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**FLOW REGULATORS**
*See also VALVES*
**Design**
Alternative flow control nozzles: energy dissipation of highly erosive fluids, 12:36247 (RA;US)
**Performance Testing**
Alternative flow control nozzles: energy dissipation of highly erosive fluids, 12:36247 (RA;US)
**FLOWMETERS**
**Computerized Control Systems**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)
**Data Acquisition Systems**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)
**Design**
Advanced research in instrumentation and control technology: capacitance flowmeter, 12:36243 (RA;US)
**Performance Testing**
Advanced research in instrumentation and control technology: capacitance flowmeter, 12:36243 (RA;US)
**FLUE GAS**
**Chemical Analysis**
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)
**Cleaning**
High-temperature control of contaminants in coal-derived gases, 12:36283 (BA;US)
**Denitrification**
Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
Influence of the electrolyte concentration on the absorption of the NO/sub x/ components N/sub 2/O/sub 4/ and N/sub 2/O/sub 3/ in aqueous solutions, 12:37526 (R;DE;In German)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
**Desulfurization**
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)

Combined NO/sub x//$SO_2$ removal from flue gas using ferrous chelates of SH-containing amino acids and alkali, 12:36329 (R;US)
Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
Flue gas desulphurisation: system performance, 12:37611 (R;GB)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
Properties of CuO sorbents related to $SO_2$ reactivity, 12:36760 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
Thermal oxidation of waste from wet-dry flue gas desulfurization and reuse of the final product, 12:36766 (R;SE;In Swedish, English and German)

**Heat Recovery Equipment**
Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)

**Hot Gas Cleanup**
Applications of separations technology for the control of pollutants in advanced coal combustion systems, 12:36336 (BA;US)

**Multi-Element Analysis**
Development of inductively coupled plasma spectroscopy for on-line analysis, 12:36300 (RA;US)

**Pollutants**
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)

**FLUID MECHANICS**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)

**FLUIDIZED BED**
*See FLUIDIZED BEDS*

**FLUIDIZED BED BOILERS**
**Waste Product Utilization**
Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)

**FLUIDIZED BEDS**
**Fluid Mechanics**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)

**Heat Transfer**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)

**FLUIDIZED-BED COMBUSTION**
**Fluid Mechanics**
Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986, 12:36354 (R;US)

**FLUIDIZED-BED COMBUSTORS**
**Air Heaters**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)

**Control Systems**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)

**Design**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)

**Economics**
Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)

**Erosion**
Erosion calculations in a two-dimensional fluidized bed, 12:36352 (R;US)

**Materials**
Materials for FBC [fluidized-bed combustion] air heater applications, 12:36351 (R;US)

**Materials Testing**
Materials for FBC [fluidized-bed combustion] air heater applications, 12:36351 (R;US)

**Sampling**
Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University, 12:37619 (RA;US)

**Waste Product Utilization**
Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)

**FLUIDS**
*Not for BODY FLUIDS.*
*See also DRILLING FLUIDS*
*FRACTURING FLUIDS*
*GASES*
*GEOTHERMAL FLUIDS*
*HEAT TRANSFER FLUIDS*
*LIQUIDS*

**Convection**
Analytic theory for the linear stability of the Saffman—Taylor finger, 12:38105 (J;US)

**Density**
On the role of density fluctuations in the entropy of a fluid, 12:38311 (J;US)

**Entropy**
On the role of density fluctuations in the entropy of a fluid, 12:38311 (J;US)

**Hard-Sphere Model**
[Some basic research problems related to energy: Progress report], 12:38101 (R;US)

**Instability**
Analytic theory for the linear stability of the Saffman—Taylor finger, 12:38105 (J;US)

**Scattering**
[Some basic research problems related to energy: Progress report], 12:38101 (R;US)

**FLUID-STRUCTURE INTERACTIONS**
**Meetings**
Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)

**FLUORESCENCE SPECTROSCOPY**
**Performance Testing**
Optical detection of alkali compounds, 12:36302 (RA;US)

**FLUORESCENT CONCENTRATORS**
*See LUMINESCENT CONCENTRATORS*

**FLUORIDES**
*See also SULFUR FLUORIDES*
*URANYL FLUORIDES*

**Biological Effects**
Tree-growth, ARMA modelling and pollution, 12:37955 (RA;US)

**FLUORIMETRY**
*See FLUORESCENCE SPECTROSCOPY*

**FLUX JUMPS**
*See MAGNETIC FLUX*

**FLUX (MAGNETIC)**
*See MAGNETIC FLUX*

**FLUX (NEUTRON)**
*See NEUTRON FLUX*

**FLUX PINNING**
*See MAGNETIC FLUX*
**FLUXOIDS**
*See MAGNETIC FLUX*
**FLY ASH**
**Hydration**
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Hydrochloric Acid**
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
**Leaching**
Chemical form and leachability of inorganic trace elements in coal ash: Final report, 12:36328 (R;US)
**Morphology**
Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces, 12:36321 (J;US)
**Particle Size**
Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier, 12:36337 (RA;US)
Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces, 12:36321 (J;US)
**Quantitative Chemical Analysis**
Pulsed-laser photothermal refraction detection in capillary liquid chromatography, 12:37385 (J;US)
**Waste Disposal**
Environmental problems involved in the disposal of fly ash from waste incineration on waste dumps. Summaries, 12:37807 (R;DE;In German)
**Waste Product Utilization**
Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
**FOAMS**
*See also PLASTIC FOAMS*
**Fluid Flow**
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)
**Mechanical Tests**
Mechanical testing of carbon foam, 12:37341 (R;US)
**Rheology**
Critical review of the foam rheology literature, 12:37415 (J;US)
**Thermal Expansion**
Thermal expansion of low-density microcellular foams, 12:37351 (R;US)
**FOG**
**Distribution**
Study of fog formation and developments on the industrial plants at Lacq (France). Role of condensation nuclei, 12:37608 (R;FR;In French)
**FOILS**
*Thinner than PLATES or SHEETS.*
**Dielectric Properties**
Measurement of x-ray dielectric constants with coherent transition radiation, 12:37509 (R;US)
**FOLIAGE**
*See LEAVES*
**FOOD**
*See also MILK*
**Radioactivity**
Radioactivity in foods - Chernobyl and the consequences, 12:37817 (R;DE;In German)
**FOOD CHAINS**
**Mathematical Models**
Temporal variation in regulation of production in a pelagic food web model, 12:37833 (R;US)
**FOOD INDUSTRY**
*See also DAIRY INDUSTRY*
**Energy Conservation**
Energy conservation in the food industry: Follow-up report, 12:37130 (R;US)
**Hazardous Materials**
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
**FOOD IRRADIATION**
*See FOOD PROCESSING*
**FOOD PROCESSING**
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**FOODSTUFFS**
*See FOOD*
**FORECASTING**
**Computer Codes**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**FORESTRY**
**Economics**
What does the wood customer expect from inventories of endangered forests, 12:37894 (RA;DE)
**Harvesting**
New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
**Meetings**
Inventorying and monitoring endangered forests, 12:37768 (R;DE;In English, French and German)
**Political Aspects**
What does a forest politician expect from forest inventory, 12:37893 (RA;DE;In German)
**FORESTS**
**Aerial Monitoring**
Comparative damage classifications using scanner data from from different flight altitudes, 12:37781 (RA;DE;In German)
Small scale aerial IR-photographs for inventory of forest damage - experiences from Swedish test areas, 12:37730 (RA;DE)
Spectral signatures of damaged spruce stands measured from a helicopter, 12:37772 (RA;DE)
**Biological Stress**
Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)
Forest disturbance and tree-ring analysis, 12:37744 (RA;US)
**Carbon Cycle**
Role of boreal forests in atmosphere-biosphere exchange of carbon dioxide, 12:37603 (RA;US)
**Harvesting Equipment**
Short-rotation harvester/chipper, 12:36633 (R;XE)
**Inventories**
Inventorying and monitoring endangered forests, 12:37768 (R;DE;In English, French and German)
Inventorying and monitoring endangered forests. Welcoming remarks, 12:37769 (RA;DE)
What does the wood customer expect from inventories of endangered forests, 12:37894 (RA;DE)
What does the customer expect from inventories of endangered forests, 12:37895 (RA;DE;In German)
**Management**
Factors affecting the growth response of ponderosa pine to prescribed burning, 12:37756 (RA;US)
Management effects in British tree-ring series, 12:37757 (RA;US)
Tree-ring studies and the reconstruction of woodland management practices in antiquity, 12:38027 (RA;US)

**Monitoring**
Abrupt changes in growth reflected in tree ring sequences as an expression of biotic and abiotic influences, 12:37798 (RA;DE)
Applicability of Landsat-4 Thematic Mapper data for forest classifications, 12:37782 (RA;DE;In German)
Application of airborne digital multispectral scanner data and testing of spaceborne data for the evaluation of forest degradation, 12:37773 (RA;DE)
Application of computerised systems to the nation-wide forest inventory in Denmark with emphasis on the possibilities of conducting inventory and monitoring of endangered forests, 12:37803 (RA;DE)
Approach and methodology for monitoring of the health of forests in Sweden, 12:37785 (RA;DE)
Austrian survey on forest condition, 12:37790 (RA;DE;In German)
Cantonal surveys of forest disease to complement national programs, 12:37788 (RA;DE;In German)
Colour infrared air-photointerpretation by hexagon-methods to detect forest decline in Northrhine-Westphalia, 12:37777 (RA;DE)
Combination of different methods of surveying and analysing forest decline to create a basis to investigate the causes, as practised in West-Berlin, 12:37601 (RA;DE;In German)
Control sampling for close-to-nature silviculture, 12:37804 (RA;DE;In German)
Exemplary assessment of forest monitoring from air pollution. Analysis of diameter increase variations, 12:37799 (RA;DE;In German)
Flexible system to monitor the health status of a forest, 12:37791 (RA;DE;In German)
Integrated coverage of the condition of the forest. Multiple recording of data for an exemplary stand in Bavaria, 12:37794 (RA;DE;In German)
International monitoring - an achievable goal, 12:37771 (RA;DE)
Inventorying and monitoring endangered forests in the People's Republic of Poland, 12:37793 (RA;DE;In German)
Investigations performed on permanent observation plots established by the Forest Research Institute (FVA) of the State of Baden-Wuerttemberg, 12:37792 (RA;DE;In German)
Is ecosystem theory a basis for the inventory and monitoring of endangered forest, 12:37770 (RA;DE)
Large-area inventory of forest damage by means of aerial infrared thermography on a scale of 1:9000, 12:37779 (RA;DE;In German)
Mapping and health status assessment of the Flemish forests using remote sensing, 12:37731 (RA;DE)
Method of inventorying and evaluating the state of water and soil conservation in artificial forest, 12:37732 (RA;DE)
Monitoring the modifications in the forest ecosystem of the Brazilian Amazon region through remote sensing techniques, 12:37938 (RA;DE)
Monitoring the growth and health of white pine in New Hampshire, 12:37784 (RA;DE)
Multi-temporal Landsat data for detection and mapping of forest damage. Experiences from a test area in Schwarzwald, West Germany, 12:37729 (RA;DE)
Observed tree diseases and forest damages in the Finnish National Forest Inventory, 12:37787 (RA;DE)
On the application of dendrochronology for the evaluation of forest damage, 12:37797 (RA;DE)
Pilot survey for a European inventory of forest decline, 12:37789 (RA;DE;In German)
Present and future applications of remote detection, 12:37774 (RA;DE;In French)
Problems concerning the French monitoring grid of forest decline, 12:37775 (RA;DE;In French)
Remote detection in forestry industry and the determination of damage from flue gases by aerial infrared thermography, 12:37776 (RA;DE;In German)
Results of computerized multispectral scanning of forest damage, 12:37780 (RA;DE;In German)
Review of recent FAO contributions to inventorying and monitoring of tropical forests (1979-1985), 12:37896 (RA;DE)
Sampling for branch, tree and stand estimates of crown biomass, 12:37786 (RA;DE)
Special inventories to record the state of health of forest in Hungary and its improvement, 12:37940 (RA;DE;In German)
Standardized system for monitoring of air pollution effects on forests in the CSSR, 12:37795 (RA;DE;In German)
Survey to assess the effects of atmospheric deposition on forest vegetation, 12:37783 (RA;DE)
Towards forest stress detection with digitized color infrared imagery, 12:37778 (RA;DE)
Towards the integrated use of satellite data for forest inventories. A methodological perspective, 12:37800 (RA;DE)
Trace element analysis of wood, a tool for monitoring air pollution, 12:37796 (RA;DE)
Use of logistic regression model in the statistical analysis of forest damage, 12:37802 (RA;DE)
What does a forest politician expect from forest inventory, 12:37893 (RA;DE;In German)

**Pathological Changes**
Bilateral information meeting Hungary-Austria, subject 'forest decline', 12:37989 (R;DE;In German)
Documentation of publications on the subject of forest damage. As of July 1986, 12:37958 (R;DE;In German)

**Population Dynamics**
Forest disturbance and tree-ring analysis, 12:37744 (RA;US)

**Productivity**
Comparative studies on the annual ring pattern and crown condition of conifers (the Valais, Switzerland), 12:37754 (RA;US)
Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California, 12:37946 (RA;US)
Increasing net primary productivity in Washington (USA) forests during the last 100 years, 12:37942 (RA;US)
Potential physiological and ecological effects of increasing $CO_2$ on forests, 12:37948 (RA;US)
Productivity in fossil forests, 12:38026 (RA;US)
Southern forest growth trends: air pollution influence studies and tree-ring analysis, 12:37943 (RA;US)

**Revegetation**
Forestry and forest industries in Liberia. An example in ecological destabilization, 12:37897 (R;DE)

**Sampling**
Problems in the planning of forest damage inventories, 12:37801 (RA;DE)

**Sulfur Dioxide**
Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo, 12:37671 (R;US)

**FORMALDEHYDE**

**Decomposition**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)

**Indoor Air Pollution**
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)

**Testing**
Organic compounds evaporating from building materials into indoor atmosphere, 12:37091 (R;FI;In Finnish)

**FORMALIN**
*See FORMALDEHYDE*

**FORMALITH**
*See FORMALDEHYDE*

**FORMIC ACID**

**Catabolism**
Anaerobic catabolism of formate to acetate and $CO_2$ by Butyribacterium methylotrophicum, 12:38008 (J;US)

**Decomposition**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)

**FORMIC ALDEHYDE**
*See FORMALDEHYDE*

**FORMOL**
*See FORMALDEHYDE*

**FORMOSA**
*See TAIWAN*

**FOSSIL FUEL RESERVES**
*See FOSSIL FUELS*

**FOSSIL FUELS**
*See also COAL, NATURAL GAS, OIL SANDS, OIL SHALES, PEAT, PETROLEUM, SHALE OIL*

**Burners**
Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)

**Forecasting**
A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)

**FOSSIL-FUEL POWER PLANTS**

**Acid Rain**
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)

**Air Pollution Abatement**
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)

**Boilers**
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)

**Cooling Systems**
Study of saline water use at the Harry Allen Generating Station. Final report, 12:36756 (R;US)

**Environmental Impacts**
Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report, 12:36762 (R;US)

**Pollution Control Equipment**
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)

**Waste Water**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)

**FOSSILS**

**Isotope Dating**
Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)

**FRACTURED FORMATIONS**
*See FRACTURED RESERVOIRS*

**FRACTURED RESERVOIRS**

**Liquid Flow**
An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)

**Multiphase Flow**
An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)

**Porosity**
An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)

**Rock-Fluid Interactions**
Case history of hydraulic fracture performance in the naturally fractured Paludal zone: The transitory effects of damage, 12:36457 (BA;US)

**FRACTURES**
*See also HYDRAULIC FRACTURES*

**Configuration**
Hydraulic and mechanical properties of natural fractures in low-permeability rock, 12:38043 (R;US)

**FRACTURING FLUIDS**

**Gelation**
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)

**Losses**
Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)

**Performance**
Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)

**Rheology**
Mechanisms controlling fracture height growth in layered media, 12:36392 (BA;US)
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)

**Rock-Fluid Interactions**
Case history of hydraulic fracture performance in the naturally fractured Paludal zone: The transitory effects of damage, 12:36457 (BA;US)

**FRAGMENTATION**
A strain-rate-dependent spall mechanism transition in metals, 12:37242 (R;US)

**FRAGMENTS (FALLOUT)**
*See FALLOUT*

**FRAGMENTS (PARTICLES)**
*See PARTICLES*

**FRASCATI TOKAMAK**
*See FT TOKAMAK*

**FREE CONVECTION**
*See NATURAL CONVECTION*

**FREE ELECTRON LASERS**

**Amplification**
Measurements of amplification and phase shift (wave refractive index) in a free-electron laser, 12:37472 (R;US)

**Beam Analyzers**
Cherenkov and transition radiation diagnostics for high energy free-electron lasers, 12:37483 (R;US)

**Computer-Aided Design**
Optical analysis of high power free electron laser resonators, 12:37484 (R;US)

**Laser Mirrors**
Optical analysis of high power free electron laser resonators, 12:37484 (R;US)

**Microtrons**
Increase of current from 35 to 120 mA of the 20 MeV Frascati microtron, 12:37482 (R;IT)

**Microwave Radiation**
Free-electron laser success explained, 12:37492 (J;US)

**Near Infrared Radiation**
Free-electron laser success explained, 12:37492 (J;US)

**Operation**
Analytical treatment of Free Electron Laser in the long pulse limit, 12:37477 (R;IT)
Instability in a multimode Free Electron Laser: effects of electron energy drift, 12:37476 (R;IT)
Self-consistent classical analysis of a start-up in a Free Electron Laser, 12:37478 (R;IT)
Spontaneous emission in Cerenkov FEL devices: a preliminary theoretical and experimental analysis, 12:37479 (R;IT)

**Performance Testing**
Optical analysis of high power free electron laser resonators, 12:37484 (R;US)

**Phase Shift**
Measurements of amplification and phase shift (wave refractive index) in a free-electron laser, 12:37472 (R;US)

**Research Programs**
Research and development activities on the Free Electron Laser (FEL) at the ENEA Frascati Energy Researches Center, 12:37475 (R;IT;In Italian)
**Waveguides**
Spontaneous emission in a double dielectric slab for Cerenkov-FEL operation, 12:37480 (R;IT)
**Wiggler Magnets**
A high gain free electron laser amplifier design for the Alcator-C tokamak, 12:37518 (R;US)

**FREE STEERED VEHICLES**
*See TRACKLESS VEHICLES*

**FREEZERS**
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)

**FREEZING**
**Uses**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)

**FREONS**
**Physical Properties**
Heavy-liquid cycloning of fine-size coal (Freon-113), 12:36233 (R;US)

**FRESH WATER ECOSYSTEMS**
*See AQUATIC ECOSYSTEMS*

**FRESNEL LENS**
**Antireflection Coatings**
Sol-gel AR films for solar applications, 12:37369 (BA;US)

**FRICTION**
**Measuring Instruments**
A device to measure friction coefficients and contact resistance inside a scanning Auger microscope, 12:37578 (R;US)

**FRM DEVICES (THERMONUCLEAR)**
*See FIELD-REVERSED MIRROR REACTORS*

**FT TOKAMAK**
**Plasma Confinement**
Contributions to the 14th symposium on fusion technology, 12:38379 (R;IT)

**FTR REACTOR (RICHLAND)**
*See FFTF REACTOR*

**FUEL CANS**
**Eddy Current Testing**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Materials Testing**
Performance of refractory alloy-clad fuel pins, 12:36788 (R;US)
**Physical Radiation Effects**
Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)
**Thickness**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Ultrasonic Testing**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)

**FUEL CELL POWER PLANTS**
*For commercial, residential, or electric utility use.*
**Cogeneration**
Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
**Commercialization**
Status of commercial fuel cell powerplant system development, 12:37012 (R;US)
**Field Tests**
Follow-on 40-kW test support program: 40-kW fuel-cell field-test data analysis. Final report, April 1980-December 1986, 12:37013 (R;US)
**Hot Gas Cleanup**
Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants: Final report for the period October 1982-January 1985, 12:37011 (R;US)

**FUEL CELLS**
*See also ACID ELECTROLYTE FUEL CELLS*
**Design**
Monolithic fuel cells, 12:37010 (R;US)
**Electrodes**
High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells, 12:37009 (R;US)
**Materials Testing**
High-resolution computer tomography for flaw detection in advanced thin-layer ceramics for fuel cells, 12:37009 (R;US)
**Uses**
Monolithic fuel cells, 12:37010 (R;US)

**FUEL CONSUMPTION**
Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
**Taxes**
Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats, 12:36955 (R;US)

**FUEL COOLING INSTALLATIONS**
*See SPENT FUEL STORAGE*

**FUEL ELEMENTS**
*See also FUEL RODS*
*SPENT FUEL ELEMENTS*
**Bonding**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Eddy Current Testing**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Fuel Cans**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**Ultrasonic Testing**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)

**FUEL GAS**
*See also HIGH BTU GAS*
*NATURAL GAS*
**Desulfurization**
Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants: Final report for the period October 1982-January 1985, 12:37011 (R;US)
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Hot Gas Cleanup**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)

**FUEL OILS**
*See also RESIDUAL FUELS*
**Combustion**
Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Meetings**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)
**Prices**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Uses**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)

**FUEL PELLETS**
**Evaporation Model**
Alcator pellet evaporation data and the classical flux limit parameter, 12:38339 (R;US)
**FUEL REPROCESSING**
*See REPROCESSING*
**FUEL REPROCESSING PLANTS**
**Decommissioning**
Decontamination of the Scrap Removal Room at the West Valley Demonstration Project (Scrap Removal Room), 12:36508 (R;US)
**Decontamination**
Decontamination of the Scrap Removal Room at the West Valley Demonstration Project (Scrap Removal Room), 12:36508 (R;US)
**Radioactive Waste Processing**
Recovery of transuranics from process residues, 12:36513 (R;US)
**Radioactive Waste Storage**
Design of saltstone vaults, 12:36512 (R;US)
**FUEL ROD CONSOLIDATION**
*See FUEL RODS*
**FUEL RODS**
**Burnup**
Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project, 12:36782 (R;US)
**Testing**
Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project, 12:36782 (R;US)
**FUEL SHEATHS**
*See FUEL CANS*
**FUEL SLUGS**
*See FUEL RODS*
**FUEL SLURRIES**
**Acoustic Measurements**
Advanced research in instrumentation and control technology: acoustic parameter studies, 12:36306 (RA;US)
**Chemical Preparation**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Combustion**
Development of an advanced high efficiency coal combustor for boiler retrofit: Quarterly report for the period November 1986 to January 1987, 12:36361 (R;US)
**Combustion Kinetics**
Imaging and control instrumentation for studying the combustion behavior of single fuel droplets, 12:36359 (RA;US)
**Procurement**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling, 12:37131 (R;US)
**Production**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Task 2.0, Fuel preparation, beneficiation and handling, 12:37131 (R;US)
**Rheology**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Sedimentation**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Slurry Pipelines**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Stability**
A program of basic research on the preparation and stability of coal/water slurries: Final report, 12:36360 (R;US)
**Uses**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)
**Viscosity**
Advanced research in instrumentation and control technology: acoustic parameter studies, 12:36306 (RA;US)
**FUEL SUSPENSIONS**
*See FUEL SLURRIES*
**FUELS**
*See also AUTOMOTIVE FUELS*
*AVIATION FUELS*
*BOILER FUELS*
*FOSSIL FUELS*
*FUEL SLURRIES*
*JET ENGINE FUELS*
*LIQUID FUELS*
*REFUSE DERIVED FUELS*
*WOOD FUELS*
**Recovery**
STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)
**FUELWOOD**
*See WOOD FUELS*
**FUMES**
*See AEROSOLS*
**2-FURALALDEHYDE**
*See FURFURAL*
**FURANS**
*See also FURFURAL*
*TETRAHYDROFURAN*
**Biodegradation**
Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli, 12:37870 (J;US)
**Chemical Reaction Yield**
[Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)
**Diels-Alder Reaction**
[Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)
Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)
**Dimerization**
[Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)
**FURFURAL**
**Chemical Reaction Yield**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**FURNACES**
*See also GAS FURNACES*
*SOLAR FURNACES*
**Computerized Control Systems**
Accurate temperature control of the reheating process at mixed cold and hot charging, 12:37110 (RA;SE)
Optimizing heat distribution in continuous furnaces using a dynamic mathematical model, 12:37111 (RA;SE)
Reheating furnace automatization, 12:37112 (RA;SE)
Sophisticated reheating furnace with outstanding combustion control for high quality and energy efficiency, 12:37126 (RA;SE)
**Cost**
Molybdenum resistance heater, 12:37524 (J;US)
**Design**
Optimum design and energy saving measures of a new billet mill furnace, 12:37125 (RA;SE)
**Efficiency**
Energy optimisaton at the Whyalla reheating furnace, 12:37128 (RA;SE)
**Energy Conservation**
Energy optimisaton at the Whyalla reheating furnace, 12:37128 (RA;SE)
New slab reheating turnace of Sollac, 12:37116 (RA;SE)
Optimum design and energy saving measures of a new billet mill furnace, 12:37125 (RA;SE)
Plant solutions to reduce energy consumption in reheating furnaces, 12:37127 (RA;SE)
Reheating furnace technology in Kawasaki steel corporation, 12:37115 (RA;SE)
**Fuel Substitution**
Replacement of petroleum based fuels with lean gas in reheating furnaces, 12:37124 (RA;SE)

**Heat Recovery**
High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report, 12:37138 (R;US)
Low temperature heat recovery, 12:37104 (R;GB)
**Heat Transfer**
Numerical analysis of heat transfer in continuous reheating furnace, 12:37107 (RA;SE)
**Mathematical Models**
Mathematical reheating furnace models in STEELTEMP, 12:37106 (RA;SE)
Modelling, simulation and optimization of heating of metal in reheating furnaces, 12:37108 (RA;SE)
**Oxygen Enrichment**
Modernization of soaking pit furnaces with the aim of achieving lower energy consumption, 12:37120 (RA;SE)
Oxygen enrichment of continuous reheat furnace to increase productivity and reduce fuel consumption, 12:37119 (RA;SE)
Use of oxygen for heating furnaces, 12:37118 (RA;SE)
**Process Control**
Process control of continuous heating furnaces - strategy of a calculation model and operating results, 12:37113 (RA;SE)
Sophisticated reheating furnace with outstanding combustion control for high quality and energy efficiency, 12:37126 (RA;SE)
**Temperature Control**
Energy saving by furnace automation, 12:37114 (RA;SE)
New heating technique for improving product quality and an example of its application, 12:37117 (RA;SE)
Process control of continuous heating furnaces - strategy of a calculation model and operating results, 12:37113 (RA;SE)
**Temperature Measurement**
Two sensor measurement of slab temperature in reheat furnace: results of controlled trials on gas and oil fuels, 12:37105 (RA;SE)
**FUSED SALTS**
*See MOLTEN SALTS*
**FUSION ENERGY**
*See THERMONUCLEAR REACTORS*
**FUSION REACTIONS**
*See HEAVY ION FUSION REACTIONS*
**FUSION REACTORS**
*See THERMONUCLEAR REACTORS*
**FUSION (WELDING)**
*See WELDING*

## G

**G CODES**
GASPAR II: Technical reference and user guide, 12:37931 (R;US)
**GADOLINIUM 152**
**Neutron Reactions**
Neutron capture resonances of /sup 152/Gd and /sup 154/Gd, 12:38278 (J;US)
**GADOLINIUM 154**
**Neutron Reactions**
Neutron capture resonances of /sup 152/Gd and /sup 154/Gd, 12:38278 (J;US)
**GALLIC ACID**
**Catabolism**
Metabolism of gallate and phloroglucinol in Eubacterium oxidoreducens via 3-hydroxyl-5-oxohexanoate, 12:38009 (J;US)
**GALLIUM**
**X-Ray Fluorescence Analysis**
The application of a synchrotron radiation microprobe to trace element analysis, 12:37873 (R;US)
**GALLIUM ARSENIDE SOLAR CELLS**
**Charge Carriers**
Graded-bandgap solar cells. Annual report, 1 September 1985-31 August 1986, 12:36620 (R;US)
**Photosensitivity**
Graded-bandgap solar cells. Annual report, 1 September 1985-31 August 1986, 12:36620 (R;US)
**Spectral Response**
Spectral mismatch correction for GaAs solar cells with varying junction depths, 12:36643 (J;GB)
**GALLIUM ARSENIDES**
**Chemical Reactions**
A TEM [transmission electron microscopy] study of rhodium on GaAs: Reactions and morphology, 12:37514 (R;US)
**Electric Contacts**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Electrical Properties**
GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature (T > 300°C), power electronic applications, 12:37517 (R;US)
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Interfaces**
Ion beam characterization of thin film metal/GaAs interface reactions, 12:37513 (R;US)
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Ion Implantation**
Photoluminescence study of germanium-implanted gallium arsenide. Master's thesis, 12:37327 (R;US)
**Manufacturing**
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
**Molecular Beam Epitaxy**
Successful molecular beam epitaxy growth and characterization of (110) GaAs/GaAs and (110) AlGaAs/GaAs, 12:37339 (R;US)
The structure of GaAs/Si(211) heteroepitaxial layers, 12:37340 (R;US)
**Photoluminescence**
Photoluminescence study of germanium-implanted gallium arsenide. Master's thesis, 12:37327 (R;US)
**Physical Radiation Effects**
Mechanism of Schottky barrier formation: The role of amphoteric native defects, 12:37357 (J;US)
**Schottky Barrier Diodes**
Mechanism of Schottky barrier formation: The role of amphoteric native defects, 12:37357 (J;US)
**GAMMA DOSIMETRY**
**Gamma Spectroscopy**
Radiation dosimetry through spectral definition, 12:37572 (J;NL)
**GAMMA RADIATION**
**Absorption**
New buildup factor data for point kernel calculations, 12:38291 (R;US)
**Detection**
High-energy neutral radiations from the sun, 12:38051 (R;US)
**Radiation Doses**
New buildup factor data for point kernel calculations, 12:38291 (R;US)
**Shielding**
New buildup factor data for point kernel calculations, 12:38291 (R;US)
**Standards**
New buildup factor data for point kernel calculations, 12:38291 (R;US)
**GAMMA REACTIONS**
*See PHOTONUCLEAR REACTIONS*
**GAMMA SPECTROMETERS**
**Fabrication**
Achieving ultralow background in a germanium spectrometer, 12:37569 (R;US)
**GAMMA SPECTROSCOPY**
**Corrections**
Implementation of the pulse injection technique for dead-time and pileup corrections in gamma spectroscopy suitable for automated systems, 12:37570 (J;NL)

**GAMMA-RAY LASERS**
*See GASERS*
**GARNETS**
*For silicate garnets only.*
**Crystal Growth**
Growth of garnet crystals for laser applications. Final report, 1 February-31 July 1984, 12:37485 (R;US)
**GAS ANALYSIS**
An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
**Fabrication**
Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors, 12:37519 (J;US)
**Sampling**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
**Semiconductor Diodes**
Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors, 12:37519 (J;US)
**Standards**
Second performance audit of inspection and maintenance calibration gases, 12:37637 (R;US)
**GAS APPLIANCES**
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**GAS BEARINGS**
**Design**
A design procedure to tune the dynamic stiffness of an externally pressurized gas bearing, 12:37469 (R;US)
**GAS CENTRIFUGES**
**Gas Flow**
Computer-extended series for a source/sink driven gas centrifuge, 12:36483 (J;GB)
**GAS CONDENSATE FIELDS**
**Mathematical Models**
New extended black oil model for simulating gas cycling in retrograde condensate reservoirs, 12:36370 (R;GB)
**Simulation**
New extended black oil model for simulating gas cycling in retrograde condensate reservoirs, 12:36370 (R;GB)
**GAS CONDENSATE WELLS**
**Hydraulic Fracturing**
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
**Production**
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
**GAS COOLANTS**
*See GASES*
**GAS ENGINES**
*See INTERNAL COMBUSTION ENGINES*
**GAS FIELDS**
*See NATURAL GAS FIELDS*
**GAS FLOW**
*See also AIR FLOW*
*SLIP FLOW*
**Energy Transfer**
Kinetic model for the vibrational energy exchange in flowing molecular gas mixtures. Ph.D. Thesis, 12:37491 (TG;US)
**GAS FURNACES**
**Design**
Development of an advanced gas-fired furnace for high-temperature heating of continuously cast thin-section steel products. Final report, January-December 1986, 12:36463 (R;US)
**Flue Gas**
Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)
**GAS GENERATORS**
**Heat Recovery Equipment**
Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)
**Pressure Release**
Coal slurry letdown device, 12:36245 (RA;US)
**GAS INJECTION**
**Bench-Scale Experiments**
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)
**GAS SCINTILLATION DETECTORS**
**Design**
Evaluation of a digital optical ionizing radiation particle track detector, 12:37568 (R;US)
**GAS SPILLS**
**Data Acquisition Systems**
FDAS hardware and firmware description, liquefied gaseous fuels (LGF) data acquisition system: 1987 update, 12:36438 (R;US)
**GAS TUNGSTEN-ARC WELDING**
**Chemical Composition**
Minor element effects on gas tungsten-arc weld penetration, 12:37235 (RA;US)
**Chemical Reactions**
Origin of trace element effects on GTA weld pool shape, 12:37234 (RA;US)
**GAS TURBINE ENGINES**
**Rotors**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Vanes**
Super gripper variable vane arm, 12:37166 (P;US)
**GAS TURBINES**
**Exhaust Gases**
Parametric investigation of soot behavior and other emissions in a gas-turbine combustor. Master's thesis, 12:36461 (R;US)
**GAS WELLS**
*See NATURAL GAS WELLS*
**GASEOUS EFFLUENTS**
*See GASEOUS WASTES*
**GASEOUS WASTES**
*See also EXHAUST GASES*
*FLUE GAS*
**Multi-Channel Analyzers**
Sensor array for toxic gas detection, 12:37707 (P;US)
**Sampling**
Sensor array for toxic gas detection, 12:37707 (P;US)
**Scrubbing**
Survey of existing methods of biogas scrubbing and utilisation, 12:36587 (R;GB)
**Toxicity**
Sensor array for toxic gas detection, 12:37707 (P;US)
**GASERS**
*Gamma-ray Amplification by Stimulated Emission of Radiation.*
Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986, 12:37473 (R;US)
**GASES**
*See also AIR*
*COAL GAS*
*EXHAUST GASES*
*FUEL GAS*
*PYROLYTIC GASES*
*SYNTHESIS GAS*
**Air Pollution Monitoring**
Transition-flow reactor tube for measuring trace-gas concentrations, 12:37646 (R;US)
**Combustion**
Calculation of radiation spectrum of non-isothermal gas, 12:37444 (R;FI;In Finnish)
**Inorganic Compounds**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**Organic Compounds**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)

**Plumes**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)

**GASIFICATION**
*See also COAL GASIFICATION*
**Chemical Reaction Kinetics**
Kinetics of chemisorption and gasification reactions of carbon for evaluation of the role of electron-transfer processes. Annual report, January-December 1986, 12:36460 (R;US)

**GASOLINE**
*See also UNLEADED GASOLINE*
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Taxes**
Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats, 12:36955 (R;US)

**GASOLINE ENGINES**
*See INTERNAL COMBUSTION ENGINES*

**GENE LOCI**
*See GENES*

**GENE MUTATIONS**
**Bioassay**
Molecular approaches to the detection of germinal mutations in mammalian organisms, including man, 12:38007 (R;US)
**Screening**
Molecular approaches to the detection of germinal mutations in mammalian organisms, including man, 12:38007 (R;US)

**GENE PROMOTORS**
*See GENE REPRESSORS*

**GENE REPRESSORS**
**DNA Sequencing**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**DNA-Cloning**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**Fractionation**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)

**GENERAL RELATIVITY THEORY**
*See also RELATIVITY THEORY*
**Conformal Invariance**
Conformal invariance and torsion in general relativity, 12:38314 (J;GB)
**Quantization**
Conformal invariance and torsion in general relativity, 12:38314 (J;GB)
**Torsion**
Conformal invariance and torsion in general relativity, 12:38314 (J;GB)

**GENERATING CAPACITY**
*See CAPACITY*

**GENERATORS (ELECTRIC)**
*See ELECTRIC GENERATORS*

**GENERATORS (STEAM)**
*See STEAM GENERATORS*

**GENES**
**Cloning**
Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions, 12:37865 (J;US)

**GEOLOGIC DEPOSITS**
*See also NATURAL GAS DEPOSITS*
*PETROLEUM DEPOSITS*
*SALT DEPOSITS*
**Aquifers**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)

**GEOLOGIC FAULTS**
**Three-Dimensional Calculations**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)

**GEOLOGIC FRACTURES**
*See also GEOLOGIC FAULTS*
**Computerized Simulation**
The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project (NNWSI; jointed rock masses), 12:38046 (R;US)
**Mathematical Models**
The SPECTROM-31 Compliant Joint Model: A preliminary description and feasibility study: Nevada Nuclear Waste Storage Investigations project (NNWSI; jointed rock masses), 12:38046 (R;US)

**GEOMAGNETIC FIELD**
**Cosmic Radiation**
Correlation between asymptotic directions of cosmic-ray particles and cutoff rigidities in the evolving geomagnetic field, 12:38084 (R;US)

**GEOMAGNETIC STORMS**
*See MAGNETIC STORMS*

**GEOTHERMAL ENERGY**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)

**GEOTHERMAL EXPLORATION**
*Exploration for sources of geothermal energy.*
**Research Programs**
Cleethorpes geothermal exploration borehole. Drilling and testing programme. General report , 12:36722 (R;GB)

**GEOTHERMAL FLUIDS**
**Chemical Composition**
Geothermal research at the Puna Facility, 12:36731 (R;US)
**Two-Phase Flow**
Geothermal research at the Puna Facility, 12:36731 (R;US)

**GEOTHERMAL HEATING SYSTEMS**
**Design**
Geothermal report. Low temperature radiator systems. Stage 1. Acquisition and collation of design data, 12:36727 (R;GB)

**GEOTHERMAL RESOURCES**
**Bibliographies**
Alaska geothermal bibliography, 12:36721 (R;US)

**GEOTHERMAL SPACE HEATING**
**Water Source Heat Pumps**
Geothermal aquifer studies. Heat pump study - preliminary review. Summary and recommendations, 12:36728 (R;GB)

**GEOTHERMAL SYSTEMS**
**Economic Analysis**
Heat loads in Great Grimsby. An analysis of the practicalities and economics of a hypothetical geothermal scheme, 12:36730 (R;GB)
**Resource Assessment**
Heat loads in Great Grimsby. An analysis of the practicalities and economics of a hypothetical geothermal scheme, 12:36730 (R;GB)

**GEOTHERMAL WELLS**
**Cost Benefit Analysis**
Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes, 12:36729 (R;GB)
**Cost Estimation**
Application of the WELC well cost estimating procedure, 12:36724 (R;GB)
WELC (version 1): well cost estimating, 12:36723 (R;GB)
**Resource Assessment**
Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes, 12:36729 (R;GB)

**GERMAN FEDERAL REPUBLIC**
*See FEDERAL REPUBLIC OF GERMANY*
**GERMANES**
*See GERMANIUM HYDRIDES*
**GERMANIUM**
**Energy-Level Density**
Density-of-states calculations within the recursion method, 12:38303 (J;US)
**GERMANIUM 76**
**Double Beta Decay**
Status of double beta decay of Ge, 12:38250 (BA;US)
Ultralow background searches for $\beta\beta$-decay, cold dark matter and solar axions, 12:38248 (BA;DE)
**GERMANIUM ALLOYS**
**Electric Conductivity**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Relaxation**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Superconducting Junctions**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**GERMANIUM HYDRIDES**
**Chemical Reactions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Photochemical Reactions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**GERMANY (FEDERAL REPUBLIC)**
*See FEDERAL REPUBLIC OF GERMANY*
**GIANT RESONANCE**
**Decay**
Photon decay of giant resonances, 12:38263 (BA;DE)
**GLASS**
*See also BOROSILICATE GLASS*
*PHOSPHATE GLASS*
**Chemical Reactions**
PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)
**Melting**
PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)
**Structural Chemical Analysis**
Spectroscopic investigations of glass structure: Final report for the period April 1, 1984-December 31, 1986, 12:37334 (R;US)
**GLASSY METALS**
*See METALLIC GLASSES*
**GLAUBER THEORY**
Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**GLAUBER'S SALT**
*See SODIUM SULFATES*
**GLOW DISCHARGES**
**Positive Column**
Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis, 12:38100 (R;US)
**GLUCOSE**
**Decomposition**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**Fermentation**
Physiological adaptations of anaerobic bacteria to low pH: metabolic control of proton motive force in Sarcina ventriculi, 12:36604 (J;US)
**GLUCURONIC ACID**
**Decomposition**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**GLUEBALLS**
**Particle Production**
Physics from PEP, 12:38134 (RA;US)
Search for gluonic bound states in high energy proton-proton collisions, 12:38154 (D;US)
**Research Programs**
Experimental investigations of production of glueballs and meson resonant states, 12:38123 (R;US)
**GLUON MODEL**
**Research Programs**
[Intermediate/high energy probes and the structure of nuclei]: Final report, 12:38270 (R;US)
**GLUONIUM**
*See GLUEBALLS*
**GLUTATHIONE**
**Biological Effects**
Effect of time of glutathione depletion on ozone-induced pulmonary fibrosis, 12:37975 (RA;US)
**Biological Functions**
Possible role of reduced glutathione in the development of pulmonary fibrosis, 12:37974 (RA;US)
**Tissue Distribution**
Effect of exogenous sources of cysteine on lung glutathione levels, 12:37982 (RA;US)
**GLYCOLS**
*See also POLYETHYLENE GLYCOLS*
**Corrosive Effects**
System selection and life testing results of drain down and glycol closed loop active systems, 12:36660 (BA;US)
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**GOBAR GAS**
*See METHANE*
**GOLD**
**Degassing**
Quantum-resolved gas-surface scattering: NH/sub 3/ from Au (111), 12:38305 (BA;US)
**Dielectric Properties**
Effect of liquids on the Drude dielectric function of Ag and Au films, 12:37251 (J;US)
**Electric Contacts**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Electrical Properties**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Interfaces**
Structure and electrical properties of metal contacts on GaAs, 12:37254 (J;US)
**Ion Channeling**
Ion channeling and catastrophe theory, 12:37248 (J;US)
**Molecule Collisions**
Quantum-resolved gas-surface scattering: NH/sub 3/ from Au (111), 12:38305 (BA;US)
**GOLD 197 TARGET**
**Krypton 86 Reactions**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
**Oxygen 16 Reactions**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**GOLD ALLOYS**
*See also GOLD BASE ALLOYS*
**Order-Disorder Transformations**
X-ray scattering studies of non-equilibrium ordering processes: Progress report, August 1, 1986-October 31, 1987, 12:37217 (R;US)
**GOLD BASE ALLOYS**
**Magnetic Susceptibility**
Magnetic susceptibility of AuFe: T/sub g/ and Curie-Weiss parameters, 12:37226 (R;US)

**Segregation**
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
**Wear**
Sliding and thermally induced surface segregation in a gold based precious metal alloy, 12:37238 (R;US)
**GOLD COMPOUNDS**
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Synthesis**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**GRAIN ALCOHOL**
*See ETHANOL*
**GRAND UNIFIED THEORY**
**Rest Mass**
Fate of the m/sub b//m/sub tau/ mass relation in superstring theories, 12:38202 (J;NL)
**GRANITES**
**Permeability**
Hydraulic and mechanical properties of natural fractures in low-permeability rock, 12:38043 (R;US)
**GRANULOCYTES**
*See LEUKOCYTES*
**GRASERS**
*See GASERS*
**GRASS**
**Plant Growth**
Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)
**GRASSLANDS**
*See RANGELANDS*
**GREAT BASIN**
**Air Pollution**
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
**GREAT BRITAIN**
*See UNITED KINGDOM*
**GREAT LAKES**
**Acidification**
Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Water Quality**
Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report, 12:37845 (R;US)
**GREECE**
**Biomass Plantations**
Quality and quantity of latex which can be produced from natural vegetation in Greece, 12:36630 (R;FR)
**GREEN RIVER FORMATION**
**Hydraulic Conductivity**
Permeability of shale at elevated temperature and pressure: Test methodology and preliminary results, 12:36522 (R;US)
**GREENHOUSE PROJECT**
**Photography**
Operation Greenhouse. Scientific director's report of atomic weapon tests at eniwetok, 1951. Annex 9.1. Staff reports. Parts 1 to 4. Annex 9.4. Documentary photography, 12:37590 (R;US)
**GREENHOUSES**
**Energy Systems**
Alternative energy supply systems for lettuce production in greenhouses, 12:37145 (R;NO;In Norwegian)
**GREENLAND**
**Hydroelectric Power Plants**
Complementary preliminary investigastions. Hydroelectric power. Paakitsup Akuliarusersua, Fall 1986, 12:36611 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Text, 12:36612 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Supplement, 12:36613 (R;DK;In Danish)
Preliminary investigation hydroelectric power 1984. Power plant technology. Part report 1, Iterlaa Paamiut/Frederikshaab, 12:36614 (R;DK;In Danish)
Reindeer investigations prior to the prospective hydroelectric power project Kangerluarsunnguaq/Buksefjord Nuuk/Godthaab 1984-1985, 12:36618 (R;DK;In Danish)
**Hydrology**
Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)
**Ice**
Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)
**GROUND DISPOSAL**
**Leachates**
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**Pollution**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
**Remedial Action**
Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
**Water Pollution**
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**GROUND MOTION**
**Mathematical Models**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**Three-Dimensional Calculations**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**Two-Dimensional Calculations**
Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)
**GROUND WATER**
**Ambient Temperature**
Ground-water temperature fluctuations at Lyons Ferry Fish Hatchery, Washington, 12:37847 (J;US)
**Chemical Composition**
Trace rare earth element analysis in briny groundwaters, 12:38045 (R;US)
**Environmental Transport**
MINC [Multiple Interacting Continua]: An approach for analyzing transport in strongly heterogeneous systems, 12:38037 (R;US)
**Flow Models**
Regional ground-water flow near Richton and Cypress Creek Domes, Mississippi: Annual status report for fiscal year 1984, 12:37854 (R;US)
**Heat Extraction**
Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)
**Isotope Dating**
Carbon and isotopic mass balance models of Oasis Valley-Fortymile Canyon ground water basin, southern Nevada, 12:37823 (J;US)
**Plumes**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)

**Radionuclide Kinetics**
Tritium in groundwater at Site 300, 12:37853 (R;US)
**Water Pollution**
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**GROUNDWATER RECHARGE**
*See RECHARGE*
**GROUND-WATER RESERVES**
*See AQUIFERS*
**GROWTH (CRYSTAL)**
*See CRYSTAL GROWTH*
**GULF OF MEXICO**
**Fishes**
Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico): Sand seatrout and silver seatrout (Cynoscion arenarius; Cynoscion nothus), 12:37836 (R;US)
**GUN COTTON**
*See NITROCELLULOSE*
**GUNS**
**Projectiles**
Performance analysis of the two-stage light gas gun, 12:37468 (R;US)
**GYPSY MOTH**
*See LYMANTRIA DISPAR*

## H

**HADRON REACTIONS**
**Elastic Scattering**
Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**Inelastic Scattering**
Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**Pair Production**
Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**HADRON-HADRON INTERACTIONS**
**Pair Production**
Polarization density matrix for heavy Qanti Q production in hadron colliders, 12:38203 (J;NL)
**HADRONS**
Space-time picture of relativistic propagation of medium energy hadrons through nuclei, 12:38289 (BA;US)
**Multiple Production**
Comparison of multihadronic event generators, 12:38186 (RA;US)
Latest results from the UA2 experiment, 12:38132 (RA;US)
Physics from PEP, 12:38134 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**Particle Structure**
Changing view of hadron structure, 12:38195 (RA;US)
**HAFNIUM 181**
**Chemical Bonds**
Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy, 12:37864 (R;DE;In German)
**HALL GENERATORS**
*See MHD GENERATORS*
**HANDLING (WASTES)**
*See WASTE MANAGEMENT*
**HANFORD RESERVATION**
**Fuel Reprocessing Plants**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**HARVESTING EQUIPMENT**
**Comparative Evaluations**
Combined systems sod peat - milled peat, 12:36344 (R;SE;In Swedish)
**Design**
New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
**Field Tests**
Short-rotation harvester/chipper, 12:36633 (R;XE)
**Uses**
New machines for handling forest fuels, 12:37150 (R;SE;In Swedish)
**HATCH-2 REACTOR**
**Reactor Cooling Systems**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**HAWAII**
**Geothermal Wells**
Geothermal research at the Puna Facility, 12:36731 (R;US)
**HAZARDOUS MATERIALS**
*Not for radioactive materials.*
**Acrylonitrile**
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)
**Aerosols**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
**Air Pollution**
Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
**Air Pollution Control**
Zinc/zinc oxide preliminary source assessment, 12:37690 (R;US)
**Anesthetics**
Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York (Ethylene oxide et al.), 12:37689 (R;US)
**Arsenic Compounds**
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
**Asbestos**
Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
NESHAPS (National Emissions Standards for Hazardous Air Pollutants) asbestos demolition and renovation inspection workshop manual. Final report, 12:37726 (R;US)
**Beryllium**
Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
**Carbon Dioxide**
Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
**Chemical Properties**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
**Chlorinated Aromatic Hydrocarbons**
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma (PCBs), 12:37675 (R;US)
**Combustion Products**
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
**Data Base Management**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical

and toxicological properties of resulting materials, 12:36367 (BA;US)

**Directories**
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the rtecs computer tape. Annual edition, 12:37992 (R;US)

**Dusts**
Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)

**Epoxides**
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)

**Fire Fighting**
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)

**Formaldehyde**
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)

**Ground Disposal**
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)

**Health Hazards**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)

**Incinerators**
Real-time monitoring of a hazardous-waste incinerator with a mobile laboratory. Report for December 1986-January 1987, 12:37157 (R;US)

**Indoor Air Pollution**
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)
Information profiles on potential occupational hazards: benzoin, 12:37633 (R;US)
NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US)

**Insecticides**
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)

**Isocyanates**
Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)

**Lead**
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)

**Methylene Chloride**
Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)

**Nitrous Oxide**
Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)

**Organic Compounds**
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)

**Organic Solvents**
Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington, 12:37629 (R;US)
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)

**Particulates**
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)

**Phenols**
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)

**Physical Properties**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)

**Protective Clothing**
Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)

**Remote Handling**
Monitor - The prelude to robotics, 12:38415 (BA;US)

**Solvents**
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)

**Toxic Materials**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)

**Toxicity**
Coal conversion (liquefaction/gasification): Engineering considerations and relationships among physical, chemical and toxicological properties of resulting materials, 12:36367 (BA;US)
Mortality among uranium enrichment workers, 12:36480 (R;US)

**Waste Disposal**
Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment), 12:36973 (R;US)
Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
Superfund innovative technology evaluation (site) strategy and program plan, 12:37811 (R;US)
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)

**Waste Management**
Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)

**Waste Processing**
Superfund treatment technologies: a vendor inventory, 12:37814 (R;US)
**Waste Processing Plants**
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)
**Waste Water**
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)

**HAZARDOUS MATERIALS SPILLS**
**Bibliographies**
Bibliography on chemical emergency preparedness and prevention, 12:36967 (R;US)
**Emergency Plans**
Bibliography on chemical emergency preparedness and prevention, 12:36967 (R;US)
**Portable Equipment**
United States Coast Guard portable salvage computer. Final report, 12:36956 (R;US)

**HCDA**
*See REACTOR CORE DISRUPTION*

**H-COAL PROCESS**
**Chemical Reactors**
Hydrodynamics of four-phase fluidization: Comparison of cold-flow and operating reactor data for a gas/liquid/coal slurry fluidized bed, 12:36280 (J;US)
**Process Development Units**
Hydrodynamics of four-phase fluidization: Comparison of cold-flow and operating reactor data for a gas/liquid/coal slurry fluidized bed, 12:36280 (J;US)

**HD 8077**
*See NICKEL BASE ALLOYS*

**HEAD**
**Carcinomas**
Radium-dial workers, 12:37935 (BA;US)

**HEALTH HAZARDS**
*See also RADIATION HAZARDS*
**Data Base Management**
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)
**Risk Assessment**
Preliminary evaluations of initial TSCA (Toxic Substances Control Act) Section 8(e) substantial risk notices. January 1, 1985 to December 31, 1986, 12:37891 (R;US)
Risk assessment, management, communication: a guide to selected sources. Information guide, 12:36966 (R;US)

**HEALTH PHYSICS**
*See RADIATION PROTECTION*

**HEART**
**Radioisotope Scanning**
Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)

**HEAT DISSIPATION**
*See DIFFUSION*
*ENVIRONMENTAL TRANSPORT*
*HEAT TRANSFER*

**HEAT DISTRIBUTION SYSTEMS**
**Crevice Corrosion**
Corrosion in district heating systems. Development of an electrochemical corrosion measuring cell, 12:37156 (R;DK;In Danish)

**HEAT EXCHANGERS**
**Ceramics**
Performance verification of industrial ceramic materials: baseline study for heat-exchanger applications. Topical report, March 1984-December 1985, 12:37500 (R;US)
**Data Analysis**
Comparison of analytical and experimental immersed, collector-side heat exchanger results, 12:36693 (BA;US)
**Economics**
Heating exchanger networks, an exergo-economic study, 12:37497 (R;DE;In German)
**Enthalpy**
A T-H method for heat exchanger network synthesis, 12:36412 (J;US)
**Heat Transfer**
Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank, 12:36689 (BA;US)
**Seals**
High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report, 12:37138 (R;US)
**Service Life**
Applicability of fracture mechanics to lifetime prediction of B and W ceramic heat exchanger tubes, 12:37137 (R;US)
**Surveys**
Cost/performance analysis of high temperature waste heat recovery equipment: Final report, 12:37136 (R;US)
**Temperature Effects**
A T-H method for heat exchanger network synthesis, 12:36412 (J;US)

**HEAT OF WETTING**
*See WETTING HEAT*

**HEAT PIPES**
**Performance**
Performance correlations for high temperature potassium heat pipes, 12:36803 (R;US)

**HEAT PUMPS**
*See also AIR SOURCE HEAT PUMPS*
*SOLAR-ASSISTED HEAT PUMPS*
Optimum heat pump placement in industrial processes: Executive summary, 12:37140 (R;US)
**Air Quality**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)
**Control**
Evaluation of power control methods for free-piston Stirling engine driven heat pumps, 12:37025 (R;US)
**Evaluation**
Heat pumps. Assesment of research and development projects for the three- year period from 1981/1982 to 1983/1984, 12:37020 (R;SE;In Swedish)
Sorption - compression heat pumps and heat transformers. Technology and economics - a feasibility study, 12:37022 (R;SE;In Swedish)
**Evaporators**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Forecasting**
Projecting market demand for residential heat pumps, 12:37018 (R;US)
**Heat Transfer**
Some experimental results from a new type of evaporator for heat pumps, 12:36758 (R;FI)
**Information**
Sorption - compression heat pumps and heat transformers. Technology and economics - a feasibility study, 12:37022 (R;SE;In Swedish)
**Market**
Minority participation in new energy technologies: A case example of electric heat pumps, 12:37024 (R;US)
Projecting market demand for residential heat pumps, 12:37018 (R;US)
**Noise Pollution**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)
**Research Programs**
Heat pumps. Assesment of research and development projects for the three- year period from 1981/1982 to 1983/1984, 12:37020 (R;SE;In Swedish)
**Stirling Engines**
Evaluation of power control methods for free-piston Stirling engine driven heat pumps, 12:37025 (R;US)
**Thermal Comfort**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)

**HEAT RECOVERY**
**Heat Exchangers**
Low temperature heat recovery, 12:37104 (R;GB)
**HEAT RECOVERY EQUIPMENT**
**Carbon Steels**
Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)
**Chromium-Molybdenum Steels**
Protective coatings and claddings: applications/evaluation, 12:36252 (RA;US)
**Thermodynamics**
Thermal contact resistance in waste heat recovery systems, 12:37152 (BA;US)
**HEAT RESISTING ALLOYS**
*STAINLESS STEEL-304*
*See also STAINLESS STEEL-304L*
*STAINLESS STEEL-310*
*STAINLESS STEEL-316*
**Corrosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Erosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Research Programs**
Superalloy resources: Supply and availability, 12:37230 (R;US)
**Resources**
Superalloy resources: Supply and availability, 12:37230 (R;US)
**HEAT SOURCES (RADIOISOTOPE)**
*See RADIOISOTOPE HEAT SOURCES*
**HEAT STORAGE**
Thermal Energy Storage Evaluation Program: 1986 annual report (Economic planning, technical assessment, field tests), 12:36939 (R;US)
**HEAT STORAGE DEVICES**
*See THERMAL ENERGY STORAGE EQUIPMENT*
**HEAT STORAGE SYSTEMS**
*See THERMAL ENERGY STORAGE EQUIPMENT*
**HEAT TRANSFER**
Effects of corona on heat transfer in an enclosure. Master's thesis, 12:38099 (R;US)
**Calculation Methods**
Finite difference analysis of natural convection about a horizontal square rod in a cylindrical enclosure, 12:36492 (R;US)
**Correlations**
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
**Dryout**
Some preliminary results of post-dryout heat transfer measurements at low qualities and pressures up to 20 bar, 12:36883 (RA;US)
**Evaporators**
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
**Mathematical Models**
Mathematical reheating furnace models in STEELTEMP, 12:37106 (RA;SE)
**HEAT TRANSFER FLUIDS**
**Absorption Heat**
Laboratory tests of cleaning techniques for immiscible solar ponds, 12:36714 (BA;US)
**HEAT TRANSMISSION**
*See HEAT TRANSFER*
**HEATERS**
*See also AIR HEATERS*
*SPACE HEATERS*
*WATER HEATERS*
**Cost**
Molybdenum resistance heater, 12:37524 (J;US)
**Design**
Molybdenum resistance heater, 12:37524 (J;US)
**HEATING LOAD**
**Calculation Methods**
Generalized method to estimate the thermal performance of earth contact walls and floors, 12:37053 (RA;US)
**HEATING SYSTEMS**
*See also GEOTHERMAL HEATING SYSTEMS*
*SOLAR HEATING SYSTEMS*
**Control Systems**
Single zone control systems, 12:37074 (R;US)
**District Heating**
Conditions for solar district heating. Market analysis, 12:36680 (R;SE;In Swedish)
**Evaluation**
Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota, 12:37078 (R;US)
**Fuel Consumption**
Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
**Fuels**
1985 primary heating fuel use and switching: Assessment of the market for conservation in the Northwest: Phase 2, 12:37080 (R;US)
**Gas Burners**
Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
**Gases**
Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota, 12:37078 (R;US)
**Marketing Research**
Conditions for solar district heating. Market analysis, 12:36680 (R;SE;In Swedish)
**Retrofitting**
Evaluation of gas heating system retrofit pilot programs in Kentucky and Minnesota, 12:37078 (R;US)
**Thermal Comfort**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Working Conditions**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**HEAVY FUELS**
*See RESIDUAL FUELS*
**HEAVY ION FUSION REACTIONS**
**Angular Momentum**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**Cross Sections**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**MeV Range 10-100**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**Momentum Transfer**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**Reaction Kinetics**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**HEAVY ION REACTIONS**
*See also CARBON 12 REACTIONS*
*KRYPTON 86 REACTIONS*
*NICKEL 64 REACTIONS*
*NITROGEN 14 REACTIONS*
*OXYGEN 16 REACTIONS*
*OXYGEN 18 REACTIONS*
**Research Programs**
Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984, 12:38232 (R;US)
**HEAVY IONS**
*Whenever possible use one of the more specific terms listed under ION BEAMS.*
**Biological Radiation Effects**
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)

**Inactivation**
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)
**RBE**
Heavy-ion effects on cellular and subcellular systems: Inactivation, chromosome aberrations and strand breaks induced by iron and nickel ions, 12:37904 (R;DE)

**HEAVY LEPTONS**
*See also TAU PARTICLES*
**Particle Production**
Recent results from the UA1 experiment at CERN, 12:38131 (RA;US)
Reconstructing heavy long-lived neutral leptons, 12:38180 (RA;US)
Small visible energy events and close-mass lepton pairs, 12:38178 (RA;US)

**HEAVY MEDIA SEPARATION**
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**Comparative Evaluations**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
**Deashing**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)
**Desulfurization**
Heavy-liquid cycloning of fine-size coal, 12:36233 (R;US)

**HEAVY OILS**
*See PETROLEUM*

**HELIAC STELLARATORS**
**Performance**
Linear helical-axis stellarator experiments, 12:38336 (RA;FR)

**HELIUM 3 TARGET**
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**HELIUM TRITIDES**
**Rotational States**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
**Vibrational States**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)

**HEMICELLULOSE**
**Acid Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**Enzymatic Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)

**HEPTANE**
**Catalytic Cracking**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
**Isomerization**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)

**HERBICIDES**
**Liquid Column Chromatography**
The determination of chlorophenoxy acid herbicides by liquid chromatography using carbon-14 tracers, 12:37372 (R;US)

**HETEROCYCLIC COMPOUNDS**
*See also DIOXIN*
*FURANS*
*POLYCYCLIC SULFUR HETEROCYCLES*
*THIOPHENE*
*TTF*
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Oxidation**
Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane (Aminofurazans), 12:37400 (R;US)
**Reduction**
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Synthesis**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)

**HETEROGENEOUS REACTOR CORES**
**Burnup**
Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)

**HETEROJUNCTIONS**
*Prior to July 1981, this concept was indexed to SEMICONDUCTOR JUNCTIONS.*
**Electrical Properties**
GaAs/Al/sub 0.3/Ga/sub 0.7/As, heterojunction bipolar transistors for high-temperature (T > 300°C), power electronic applications, 12:37517 (R;US)

**HEXANE**
**Catalytic Cracking**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
**Isomerization**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)

**HIGGS BOSONS**
**Particle Production**
Higgs boson production at the $Z^0$ and the possibilities of vertex detectors, 12:38183 (RA;US)
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Summary of work on $Z^0 \rightarrow$ Higgs neutrinos antineutrinos, 12:38182 (RA;US)
Summary of work on $Z^0 \rightarrow$ Higgs anti ff, 12:38184 (RA;US)
Summary of work on QCD backgrounds to $Z^0 \rightarrow H^0$ anti ell ell, 12:38185 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Weak Particle Decay**
Summary of work on $Z^0 \rightarrow$ Higgs neutrinos antineutrinos, 12:38182 (RA;US)

**HIGH BTU GAS**
*Over 900 Btu/ft$^3$.*
**Production**
SNG from coal is a viable and required future energy supply option, 12:36285 (BA;US)

**HIGH ENERGY PHYSICS**
*Use only for articles of a very broad nature such as an annual research program, etc.*
**Computer Networks**
Aspects of computing in high energy physics, 12:38109 (RA;US)
**Computerized Simulation**
Physics simulations at high energy, 12:38207 (B;SG)
**Meetings**
Physics simulations at high energy, 12:38207 (B;SG)
**Research Programs**
A research program in experimental high energy physics: Task C, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38118 (R;US)
A research program in theoretical high-energy physics: Progress report, 12:38158 (R;US)
A research program in experimental high energy physics: Task B, Progress report for contract period January 1, 1987 to December 31, 1987, 12:38120 (R;US)
Experimental high energy physics using electromagnetic energy calorimetry: [Progress report], 12:38122 (R;US)
High energy physics: Progress report, 12:38121 (R;US)
High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984, 12:38232 (R;US)

The theory of high energy collision processes: Technical progress report, January 1, 1986 through December 31, 1986, 12:38162 (R;US)
Theoretical high energy physics research at the University of Chicago: Technical progress report [for 1986], 12:38160 (R;US)
Theoretical high energy physics: Progress report for the period May 1, 1986-April 30, 1987, 12:38157 (R;US)
**Reviews**
The future of electron-positron colliders, 12:37535 (BA;US)
**HIGH ENERGY RADIOTHERAPY**
*See RADIOTHERAPY*
**HIGH EXPLOSIVES**
*See CHEMICAL EXPLOSIVES*
**HIGH PRESSURE COOLANT INJECTION**
**Heat Transfer**
Scaling of thermal mixing phenomena from one-fifth to full scale test facilities, 12:36857 (RA;US)
Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs, 12:36856 (RA;US)
**Hydraulics**
Scaling of thermal mixing phenomena from one-fifth to full scale test facilities, 12:36857 (RA;US)
Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs, 12:36856 (RA;US)
**HIGH SPIN STATES**
**Nuclear Properties**
Electromagnetic properties of nuclei at high spins, 12:38280 (BA;DE)
**HIGH-BETA PLASMA**
*Beta from 0.1 to 1.*
**Equilibrium**
Plasma formation and equilibrium in a high $\beta$ tokamak, 12:38361 (J;US)
**HIGH-LEVEL RADIOACTIVE WASTES**
**Centrifugation**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Classification**
A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
**Filtration**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Marine Disposal**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
**Mixing**
Design of agitation systems in Bingham slurries by pilot simulation, 12:36511 (R;US)
**Radioactive Waste Disposal**
Area Recommendation Report for the Crystalline Repository Project: Volume 1, Draft, 12:36504 (R;US)
Area Recommendation Report for the Crystalline Repository Project: Volume 2, Plates: Draft, 12:36505 (R;US)
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand, 12:36535 (R;US)
Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff (NNWSI), 12:36538 (R;US)
Nuclear waste package fabricated from concrete, 12:36503 (R;US)
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
Status of geologic investigations for nuclear waste disposal at the Nevada Test Site (NNWSI), 12:36509 (RA;US)
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
The socioeconomic impacts of high-level nuclear waste facility siting, 12:36544 (BA;US)
**Radioactive Waste Processing**
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
**Radioactive Waste Storage**
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
**Remote Handling**
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
**Underground Disposal**
Analysis of a proposed NNWSI exploratory shaft slot test for tuff response, 12:36537 (R;US)
**Vitrification**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste, 12:36528 (R;US)
Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)
**Waste Transportation**
Developing a national system for transporting high-level nuclear waste, 12:36495 (BA;US)
**HIGHWAYS**
*See ROADS*
**HOG FUEL**
*See WOOD WASTES*
**HOISTS**
**Energy Storage Systems**
Applications of energy storage systems in lifting gears, 12:36936 (R;DE;In German)
**HOLMIUM 163**
**Electron Capture**
Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**Electron Capture Decay**
Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**Q-Value**
Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**HOLOCENE EPOCH**
*See QUATERNARY PERIOD*
**HOPE CREEK-2 REACTOR**
*Salem, New Jersey, USA. Prior to November 1973 known as Newbold Island-2 Reactor for the initially planned site, and older material is so indexed.*
**Pressure Vessels**
Flaw density examinations of a clad boiling water reactor pressure vessel segment, 12:36773 (R;US)
**HOSPITALS**
**Energy Conservation**
Institutional Conservation Program Evaluation Project: Results of hospital survey pretest, 12:37017 (R;US)
**Hazardous Materials**
Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)
**Surveys**
Institutional Conservation Program Evaluation Project: Results of hospital survey pretest, 12:37017 (R;US)
**HOT GAS CLEANUP**
**Economic Analysis**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Technology Assessment**
Applications of separations technology for the control of pollutants in advanced coal combustion systems, 12:36336 (BA;US)
High-temperature control of contaminants in coal-derived gases, 12:36283 (BA;US)
**HOT LABS**
**Decommissioning**
Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)

**Decontamination**
Decontamination and decommissioning of the Argonne National Laboratory East Area radioactively contaminated surplus facilities: Final report, 12:37436 (R;US)
**Safety Engineering**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)

**HOT PLASMA**
**Heat Transfer**
Nusselt number correlations for heat transfer to small spheres in thermal plasma flows, 12:37445 (J;US)
**Neutron Emission**
Calculations of total fusion power and spatial distribution of emissivity for a D-T thermal plasma. Part I, 12:38335 (R;IT)
**Nusselt Number**
Nusselt number correlations for heat transfer to small spheres in thermal plasma flows, 12:37445 (J;US)

**HOT SPOTS**
Hot-spot reaction in unsustained shocks, 12:37582 (R;US)

**HOT WATER HEATERS**
*See WATER HEATERS*

**HOUSEHOLDS**
**Behavior**
Occupant influence on energy consumption in single-family dwellings, 12:37019 (R;SE)
**Energy Conservation**
Energy conservation between environmental policy and consumer policy. Experience from eight countries, 12:37070 (R;DE;In German)

**HOUSES**
**Air Quality**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Computer-Aided Design**
Basic characteristics for low-cost houses in order to reduce the energy consumption for heating, 12:37068 (R;FR)
**Construction**
Minnesota energy efficient house research project, 12:37047 (RA;US)
**Design**
Minnesota energy efficient house research project, 12:37047 (RA;US)
**Energy Consumption**
Basic characteristics for low-cost houses in order to reduce the energy consumption for heating, 12:37068 (R;FR)
Single-family building retrofit performance monitoring protocol: Data specification guideline, 12:37077 (R;US)
**Indoor Air Pollution**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
Monitoring before and after radon mitigation, 12:37719 (R;US)
Resolving the radon problem in Clinton, New Jersey houses. Published paper, April-December 1986, 12:37718 (R;US)
**Monitoring**
Single-family building retrofit performance monitoring protocol: Data specification guideline, 12:37077 (R;US)
**Repair**
Energy related business development project: Final report (Remodeling/repair business), 12:38391 (R;US)
**Retrofitting**
Single-family building retrofit performance monitoring protocol: Data specification guideline, 12:37077 (R;US)
**Thermal Insulation**
Superinsulated houses: The importance of resale value, 12:37098 (BA;US)
**Ventilation**
The impacts of balanced and exhaust mechanical ventilation on indoor radon, 12:37712 (R;US)

**HPCI**
*See HIGH PRESSURE COOLANT INJECTION*

**HUGENHOLTZ-PINES THEORY**
*See HYDROGEN*

**HUMAN CELLS**
*See ANIMAL CELLS*

**HUMAN POPULATIONS**
*See also A-BOMB SURVIVORS*
*MINORITY GROUPS*
**Radiation Doses**
Annual Environmental Monitoring report, January through December 1986, 12:37723 (R;US)

**HUMANS**
*See HUMAN POPULATIONS*

**HUMIC ACIDS**
**Production**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**Yields**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)

**HYDRAULIC EQUIPMENT**
**Comparative Evaluations**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)

**HYDRAULIC FRACTURES**
**Acidization**
Dynamic etching tests aid fracture acidizing treatment design, 12:36390 (BA;US)
**Computerized Simulation**
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**Crack Propagation**
Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)
Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment, 12:36393 (BA;US)
Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)
Mechanical interactions in branched or subparallel hydraulic fractures, 12:36398 (BA;US)
Mechanisms controlling fracture height growth in layered media, 12:36392 (BA;US)
Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)
Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)
**Etching**
Dynamic etching tests aid fracture acidizing treatment design, 12:36390 (BA;US)
**Fracture Mechanics**
Coupling of production forecasting, fracture geometry requirements and treatment scheduling in the optimum hydraulic fracture design, 12:36391 (BA;US)
**Hydraulic Conductivity**
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**Mathematical Models**
Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment, 12:36393 (BA;US)
Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)
Mechanical interactions in branched or subparallel hydraulic fractures, 12:36398 (BA;US)
The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)
**Pressure Drop**
Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)

**HYDRAULIC FRACTURING**
**Additives**
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)
**Meetings**
Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs, 12:36388 (B;US)

**HYDRAULIC FRACTURING FLUIDS**
*See FRACTURING FLUIDS*

**HYDRAULIC MINING**
**Technology Assessment**
Thick-seam mining in the Western United States--geological considerations. Information Circular/1986, 12:36343 (R;US)

**HYDRAULIC RAMS**
*See PUMPS*

**HYDRAULIC TRANSPORT**
**Radiation Absorption Analysis**
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)

**HYDRIDES**
*See also GERMANIUM HYDRIDES*
*SILANES*
**Glass**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)
**Isotope Effects**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)

**HYDROCARBONS**
*See also ALKANES*
*ALKENES*
*ANTHRACENE*
*BENZENE*
*BENZOPYRENE*
*CAROTENOIDS*
*NAPHTHALENE*
*PHENANTHRENE*
*POLYCYCLIC AROMATIC HYDROCARBONS*
*PYRENE*
*TOLUENE*
*XYLENES*
**Chemical Analysis**
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**Chemical Preparation**
Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)
**Combustion**
Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Origin**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Oxidation**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Synthesis**
Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures, 12:36603 (R;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Waste Disposal**
Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)

**HYDROCHLORIC ACID**
**Chemical Reactions**
Dynamic behavior of reacting gas jets submerged in liquids, 12:37390 (R;US)
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Emission**
Improvements in the methodology for measuring hydrochloric acid in combustion source emissions, 12:36333 (R;US)

**HYDROCYANIC ACID**
**Chemical Analysis**
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)

**HYDROCYCLONES**
*See CYCLONE SEPARATORS*

**HYDROELECTRIC POWER**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Water Resources**
Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report, 12:36610 (R;US)

**HYDROELECTRIC POWER PLANTS**
*See also SMALL-SCALE HYDROELECTRIC POWER PLANTS*
**Engineering Geology**
Preliminary investigation hydroelectric power 1984. Power plant technology. Part report 1, Iterlaa Paamiut/Frederikshaab, 12:36614 (R;DK;In Danish)
**Environmental Effects**
White alder growth and development: the effect of small hydroelectric projects in the Sierra Nevada of California (Alnus rhombifolia), 12:36616 (RA;US)
**Environmental Impacts**
Reindeer investigations prior to the prospective hydroelectric power project Kangerluarsunnguaq/Buksefjord Nuuk/Godthaab 1984-1985, 12:36618 (R;DK;In Danish)
**Feasibility Studies**
Complementary preliminary investigastions. Hydroelectric power. Paakitsup Akuliarusersua, Fall 1986, 12:36611 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Text, 12:36612 (R;DK;In Danish)
Preliminary investigation of hydroelectric power 1984 and 1985. Study of technical premises. Iterlaa, Paamiut/Frederikshaab. Supplement, 12:36613 (R;DK;In Danish)
Preliminary investigation hydroelectric power 1984. Power plant technology. Part report 1, Iterlaa Paamiut/Frederikshaab, 12:36614 (R;DK;In Danish)
**Mapping**
Complementary preliminary investigastions. Hydroelectric power. Paakitsup Akuliarusersua, Fall 1986, 12:36611 (R;DK;In Danish)
**Operation**
Model with two reservoirs used in a multisystem model, 12:36609 (R;NO;In Norwegian)

**HYDROELECTRICITY**
*See HYDROELECTRIC POWER*

**HYDROFLUORIC ACID**
**Indoor Air Pollution**
Mortality among uranium enrichment workers, 12:36480 (R;US)

**HYDROGEN**
**Carbon 12 Reactions**
Probing the direct step of relativistic heavy ion fragmentation: ($^{12}C$, $^{11}B$+p) at 2.1 GeV/nucleon with C and $CH_2$ targets, 12:38239 (R;US)
**Chemisorption**
Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors, 12:37520 (J;US)
**Combustion**
Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)
Recent results in hydrogen research, 12:36915 (RA;US)
**Excitation**
Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams, 12:38096 (R;US)

**Ionization**
Experimental and theoretical studies of laser cooling and emittance control of neutral beams. Final report, 1 November 1981-31 January 1987, 12:38091 (R;US)
**Raman Spectroscopy**
Frequency-shift measurements of the Q(1) and Q(2) lines of $H_2$ using high-resolution c-w Coherent Anti-Stokes Raman Spectroscopy. Master's thesis, June-October 1986, 12:38092 (R;US)
**Removal**
Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor, 12:36822 (R;DE;In German)
**Spectral Shift**
Frequency-shift measurements of the Q(1) and Q(2) lines of $H_2$ using high-resolution c-w Coherent Anti-Stokes Raman Spectroscopy. Master's thesis, June-October 1986, 12:38092 (R;US)

**HYDROGEN 2**
*See DEUTERIUM*

**HYDROGEN 3**
*See TRITIUM*

**HYDROGEN CHLORIDES**
*See HYDROCHLORIC ACID*

**HYDROGEN CYANIDES**
*See HYDROCYANIC ACID*

**HYDROGEN DONOR REACTIONS**
*See HYDROGEN TRANSFER*

**HYDROGEN FLUORIDES**
*See HYDROFLUORIC ACID*

**HYDROGEN HYDROXIDES**
*See WATER*

**HYDROGEN IONS 1 PLUS**
*For $H_1^+$ ions.*
**Membrane Transport**
[Mechanism of proton pumping by bacteriorhodopsin], 12:36625 (R;US)

**HYDROGEN IONS 2 PLUS**
*For $H_2^+$ ions.*
**Molecule Collisions**
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$, 12:38097 (D;US)

**HYDROGEN IONS 3 PLUS**
*For $H_3^+$ ions.*
**Production**
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$, 12:38097 (D;US)

**HYDROGEN ISOTOPES**
*See also DEUTERIUM*
*TRITIUM*
**Research Programs**
Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87, 12:37197 (R;US)

**HYDROGEN NITRATES**
*See NITRIC ACID*

**HYDROGEN PRODUCTION**
**Photoelectrochemical Cells**
Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986, 12:36578 (R;US)

**HYDROGEN SILICATES**
*See SILICIC ACID*

**HYDROGEN SULFATES**
*See SULFURIC ACID*

**HYDROGEN SULFIDES**
**Chemical Analysis**
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)
**Monitoring**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
**Removal**
Selective absorption of hydrogen sulfide in carbon dioxide by methyldiethanolamine. Study of a new type of vertical ascending cocurrent flow contactor, 12:37375 (R;FR;In French)

**HYDROGEN TRANSFER**
**Catalysts**
Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86, 12:36266 (R;US)

**HYDROGENATION**
**Catalysts**
Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)
Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987, 12:36270 (R;US)
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
Trifunctional catalysts for conversion of syngas to alcohols: Eleventh quarterly report for period March 1, 1987 to May 31, 1987, 12:36597 (R;US)

**HYDROLASES**
*Code number 3.*
**Enzyme Activity**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
**Tissue Distribution**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)

**HYDROMETALLURGY**
**Extraction Apparatuses**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)

**HYDROXYLASE**
*See HYDROXYLASES*

**HYDROXYLASES**
*Code number 1.14*
**Enzyme Activity**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)

**HYDROXYTOLUENES**
*See CRESOLS*

**HYPERFRAGMENTS**
*See HYPERNUCLEI*

**HYPERNUCLEI**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Energy-Level Transitions**
Electromagnetic transitions in hypernuclei, 12:38242 (BA;DE)
**Shell Models**
Studies of hypernuclei by associated production, 12:38237 (R;US)

**HYPERTHERMIA**
**Biological Radiation Effects**
Evaluation of drugs for prevention of hyperthermia in rats exposed to microwave irradiation. Final report, 1983-1985, 12:38013 (R;US)

**HYSTERESIS**
**Recording Systems**
A circuit for characterization of ferroelectrics, 12:37510 (R;IN)

# I

**I CODES**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**I-BEAM TYPE REACTORS**
*See ION BEAM FUSION REACTORS*
**ICE**
**Oxygen Isotopes**
Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)
**ICE CONDENSERS**
**Testing**
Ice condenser testing facility and plans, 12:36904 (RA;US)
**ICELAND**
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**ICR HEATING**
**Computer Calculations**
An algorithm for the calculation of 3-D ICRF [Ion Cyclotron Range of Frequencies] fields in tokamak geometry, 12:38345 (R;US)
**Reflection**
Fast-wave transmission and reflection in ion-cyclotron heating, 12:38328 (R;US)
**Transmission**
Fast-wave transmission and reflection in ion-cyclotron heating, 12:38328 (R;US)
**Wave Propagation**
Fast-wave transmission and reflection in ion-cyclotron heating, 12:38328 (R;US)
**IDAHO**
**Resource Assessment**
Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual, 12:37834 (R;US)
**Rivers**
Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual, 12:37834 (R;US)
**IDAHO NATIONAL ENGINEERING LABORATORY**
*Prior to 1976 known as NRTS and older material is so indexed.*
**Alpha-Bearing Wastes**
Transuranic waste examination quality assurance at the Idaho National Engineering Laboratory, 12:36515 (R;US)
**IGNITION**
**Mathematical Models**
The shell model for hot-spot ignition, 12:37581 (R;US)
**IGT WASTE PROCESS**
*See BIOGAS PROCESS*
**ILLINOIS**
**Superconducting Super Collider**
Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: results of the Fall 1984 test-drilling program. Environmental geology notes, 12:37562 (R;US)
**IMAGE PROCESSING**
**C Codes**
Interactive software for simulation of high resolution TEM images, 12:38411 (R;US)
**Computer Graphics**
Computer-aided radiograph analysis, 12:37507 (R;US)
**IMIDES**
**Brittleness**
Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries, 12:37358 (J;US)
**IMMOBILIZATION**
*See VITRIFICATION*
**IMMUNE REACTIONS**
**Radioimmunoassay**
Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)
**IMPERFECTIONS**
*See DEFECTS*
**INCIDENTS**
*See ACCIDENTS*
**INCINERATION**
*See COMBUSTION*
**INCINERATORS**
**Air Pollution Monitoring**
Real-time monitoring of a hazardous-waste incinerator with a mobile laboratory. Report for December 1986-January 1987, 12:37157 (R;US)
**Combustion Products**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**INCLUSION COMPLEXES**
*See CLATHRATES*
**INCONEL 600**
**Radiation Effects**
Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)
**INDEXES**
*Should be used to index all pieces of literature which are indexes.*
Indexes to Nuclear Regulatory Commission issuances, July-September 1986, 12:36792 (R;US)
**INDIANA**
**Oil Shale Processing Plants**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)
**INDIUM ALLOYS**
**Superlattices**
The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices, 12:37349 (R;US)
**INDIUM ARSENIDES**
**Superlattices**
The use of compositionally graded layers to minimize surface defects in In(AsSb) strained-layer superlattices, 12:37349 (R;US)
**INDIUM COMPOUNDS**
*See also INDIUM ARSENIDES*
*INDIUM PHOSPHIDES*
*INDIUM SULFIDES*
**Crystal Structure**
YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)
**INDIUM ISOTOPES**
**De-Excitation**
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**Excited States**
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**INDIUM PHOSPHIDES**
**Neutron Diffraction**
Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report], 12:38292 (R;US)
**INDIUM SULFIDES**
**Deposition**
Feasibility of using copper indium disulfide for high-efficiency, thin-film solar cells: Final subcontract report, 1 February 1985-30 September 1986, 12:36634 (R;US)
**INDONESIA**
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**INDOOR AIR POLLUTION**
**Aerosols**
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
**Air Pollution Control**
Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)
**Bibliographies**
Bibliography on indoor radon pollution, 12:37721 (R;US)

**Dusts**
Biological dusts in indoor air and factors affecting the bioaerosol levels, 12:37085 (R;FI;In Finnish)
**Man**
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)
**Measuring Methods**
Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
**Recommendations**
Topical report on the meeting of the Gas Research Institute Indoor Air-Quality Research Advisory Committee. Final report, February 11-13, 1986, 12:37682 (R;US)
**Sampling**
Indoor air quality in new single family houses at Helsinki and Kuopio regions, 12:37086 (R;FI;In Finnish)
**Ventilation Systems**
Indoor particle concentration and the outdoor to indoor transport, Final report, 12:37094 (R;FI;In Finnish)

**INDUCTION FURNACES**
**Efficiency**
Localized inductive heating of steel products, 12:37123 (RA;SE)
**Energy Conservation**
Transverse pusher induction heater for billets using medium frequency, 12:37121 (RA;SE)
**Performance**
Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Uses**
Induction heating in rolling mills - new ideas and applications, 12:37122 (RA;SE)

**INDUCTION GENERATORS**
**Mathematical Models**
Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades, 12:36757 (R;SE)

**INDUSTRIAL PARKS**
**Fog**
Study of fog formation and developments on the industrial plants at Lacq (France). Role of condensation nuclei, 12:37608 (R;FR;In French)

**INDUSTRIAL PLANTS**
*See also CHEMICAL PLANTS*
*COAL GASIFICATION PLANTS*
*COAL LIQUEFACTION PLANTS*
*COAL PREPARATION PLANTS*
*COKING PLANTS*
*FEED MATERIALS PLANTS*
*OIL SHALE PROCESSING PLANTS*
*OXYGEN PLANTS*
*PETROLEUM REFINERIES*
*WASTE PROCESSING PLANTS*
**Closed-Cycle Cooling Systems**
Closed-cycle desiccant cooling system. Final report, Phases 1 and 2a May 1984-September 1986, 12:37079 (R;US)
**Hazardous Materials**
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)
In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)
**Heat Recovery Equipment**
Thermal contact resistance in waste heat recovery systems, 12:37152 (BA;US)
**Occupational Safety**
Fence: where the community and the workplace meet, 12:37889 (R;US)
**Toxic Materials**
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)

**INDUSTRIAL RADIOGRAPHY**
*See also BIOMEDICAL RADIOGRAPHY.*
**Image Processing**
Computer-aided radiograph analysis, 12:37507 (R;US)

**INDUSTRIAL SECTOR**
*See INDUSTRY*

**INDUSTRIAL WASTES**
**Combustion**
Waste fuels: A proven source of energy recovery, 12:36608 (BA;US)
**Mineral Wastes**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**Waste Management**
Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment), 12:36973 (R;US)
**Wood Wastes**
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)

**INDUSTRY**
*See also AGRICULTURE*
*CHEMICAL INDUSTRY*
*CONSTRUCTION INDUSTRY*
*ELECTRIC POWER INDUSTRY*
*FOOD INDUSTRY*
*METAL INDUSTRY*
*NATURAL GAS INDUSTRY*
*OIL SHALE INDUSTRY*
*PETROLEUM INDUSTRY*
*PLASTICS INDUSTRY*
*PRINTING AND PUBLISHING INDUSTRY*
*SUGAR INDUSTRY*
*TEXTILE INDUSTRY*
**Cogeneration**
Development of a coal/water-slurry-fueled diesel engine for industrial cogeneration: Final and summary report, 12:37134 (R;US)
Slow speed coal/water slurry fired diesels in industrial cogeneration: Market evaluation, 12:37135 (R;US)
**Energy Conservation**
Optimum heat pump placement in industrial processes: Executive summary, 12:37140 (R;US)
**Heat Pumps**
Optimum heat pump placement in industrial processes: Executive summary, 12:37140 (R;US)
**Load Management**
Switching-off power loads in industry, 12:36998 (R;DK;In Danish)
**Power Demand**
1986 variable industrial power rate: Executive summary of Administrator's Record of Decision, 12:36994 (R;US)
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)

**INERTIAL CONFINEMENT**
*A dynamic plasma confinement by inertial forces.*
**Research Programs**
Progress in light ion beam fusion research on PBFA II, 12:38390 (J;GB)

**INFECTIOUS DISEASES**
**Biological Indicators**
Western spruce budworm outbreaks in northern New Mexico: tree-ring evidence of occurrence and radial growth impacts from 1700 to 1983, 12:37883 (RA;US)
**Pathogenesis**
Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions, 12:37865 (J;US)

**INFRARED THERMOGRAPHY**
**Technology Utilization**
Applications of thermography, 12:37050 (RA;US)

**INHALATION**
Work performance evaluation using the exercising rat model, 12:37959 (R;US)

**INHOMOGENEOUS PLASMA**
**Wave Propagation**
Congruent reduction and mode conversion in 4-dimensional plasmas, 12:38342 (R;US)

**INJECTION WELLS**
**Directional Drilling**
Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)
**Hydraulic Fracturing**
Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)

**INORGANIC COMPOUNDS**
*Use of a more specific term is recommended.*
**Air Pollution Monitoring**
Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)
**INPUT WELL**
*See INJECTION WELLS*
**INSECTICIDES**
**Air Pollution**
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)
**INSECTS**
**Biological Indicators**
Tree-rings and insects: the influence of cockchafers on the development of growth rings in oak trees, 12:37745 (RA;US)
**IN-SITU COMBUSTION**
**Comparative Evaluations**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**Economic Analysis**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**Mathematical Models**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**IN-SITU RETORTING**
**Waste Water**
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
**INSTRUMENTS (MEASURING)**
*See MEASURING INSTRUMENTS*
**INSULATING LIMITERS**
*See LIMITERS*
**INSULATION (ELECTRICAL)**
*See ELECTRICAL INSULATION*
**INSULATION (THERMAL)**
*See THERMAL INSULATION*
**INSULATORS (ELECTRICAL)**
*See ELECTRICAL INSULATORS*
**INTEGRATED CIRCUITS**
Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987, 12:38402 (R;US)
**INTERACTIONS**
*For elementary particles and radiations only; not for CONFIGURATION INTERACTION.*
*See also PAIR PRODUCTION*
**Weinberg-Salam Gauge Model**
Neutrino emission by the pair, plasma, and photo processes in the Weinberg-Salam model, 12:38205 (J;US)
**INTERCALATES**
*See CLATHRATES*
**INTERCONNECTED POWER SYSTEMS**
**Horizontal Axis Turbines**
Measurements of power quality for a modern wind turbine, 12:36743 (R;DK;In Danish)
**INTERFACES**
**Wave Propagation**
Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
**INTERMEDIATE BOSONS**
*See also INTERMEDIATE VECTOR BOSONS*
**Particle Production**
$E^+ e^- \rightarrow W^+ W^-$ in $E_6$ models with additional neutral gauge bosons, 12:38199 (J;US)
**INTERMEDIATE VECTOR BOSONS**
*See also W MINUS BOSONS*
*W PLUS BOSONS*
*Z NEUTRAL BOSONS*
**Composite Models**
Compositeness below 1 TeV, 12:38194 (RA;US)
**INTERMETALLIC COMPOUNDS**
**Additives**
Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
**Corrosion Resistance**
Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
**Superconductivity**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
**Tensile Properties**
Development of iron aluminides for coal gasification systems, 12:36240 (R;US)
**INTERNAL COMBUSTION ENGINES**
*See also DIESEL ENGINES*
*GAS TURBINE ENGINES*
*SPARK IGNITION ENGINES*
**Ceramics**
Performance of ceramics in ring/cylinder applications, 12:37167 (B;US)
**Federal Test Procedure**
Application for certification 1987 model year heavy-duty engines, 12:37168 (R;US)
Application for certification 1987 model year heavy-duty engines - Caterpillar, 12:37169 (R;US)
Application for certification 1987 model year heavy-duty engines - Chrysler, 12:37170 (R;US)
Application for certification 1987 model year heavy-duty engines - Mitsubishi Motors corporation, 12:37171 (R;JP)
Application for certification 1987 model year light-duty vehicles, 12:37172 (R;US)
Application for certification 1987 model year light-duty vehicles - Chrysler, 12:37173 (R;US)
Application for certification 1987 model year light-duty vehicles and light-duty trucks - Ford Motor Company, 12:37174 (R;US)
Application for certification 1987 model year light-duty vehicles - General Motors, 12:37175 (R;US)
Application for certification 1987 model year light-duty vehicles - Mercedes-Benz, 12:37176 (R;US)
Application for certification 1987 model year light-duty vehicles - Nissan, 12:37177 (R;JP)
Application for certification 1987 model year light-duty vehicles - American Motors Corporation (Renault), 12:37178 (R;US)
Application for certification 1987 model year light-duty vehicles - Rolls Royce, 12:37179 (R;US)
Application for certification 1987 model year light-duty vehicles - Volkswagen, 12:37180 (R;US)
Application for certification 1987 model year light-duty vehicles, 12:37181 (R;US)
Application for certification 1987 model year light-duty vehicles - Isuzu, 12:37182 (R;US)
**INTERNAL CONTAMINATION**
*See RADIONUCLIDE KINETICS*
**INTERNAL CONVERSION**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
**INTERNAL MEDICINE**
*See MEDICINE*
**INTERSECTING BEAMS**
*See COLLIDING BEAMS*
**INTERSECTING STORAGE ACCELERATOR**
*See ISABELLE STORAGE RINGS*
**INTRUSION DETECTION SYSTEMS**
**Design**
The evolution of interior intrusion detection technology at Sandia National Laboratories, 12:36566 (R;US)
Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
**Display Devices**
Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
**INVARIANCE PRINCIPLES**
*See also CP INVARIANCE*
*P INVARIANCE*
Nuclear probes of fundamental symmetries, 12:38283 (BA;DE)
**INVESTMENT**
**Optimization**
Optimal investments using empirical dynamic programming with application to natural resources, 12:36436 (R;NO)

**IODINE**
**Removal**
Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)
**IODINE IODIDES**
*See IODINE*
**ION BEAM FUSION REACTORS**
**Atomic Physics**
Important atomic physics issues for ion beam fusion, 12:38383 (R;US)
**Experiment Planning**
Important atomic physics issues for ion beam fusion, 12:38383 (R;US)
**ION BEAM TARGETS**
**Asymmetry**
Symmetry issues in a class of ion beam targets using sufficiently short direct drive pulses, 12:38385 (R;US)
**Energy Absorption**
Near spherical illumination of ion-beam and laser targets, 12:38384 (R;US)
**ION BEAM TYPE REACTORS**
*See ION BEAM FUSION REACTORS*
**ION CYCLOTRON-RESONANCE HEATING**
*See ICR HEATING*
**ION EXCHANGE MEMBRANES**
*See MEMBRANES*
**ION PROBES**
Measurement of the local particle diffusion coefficient in a magnetized plasma, 12:38357 (J;US)
**ION-ATOM COLLISIONS**
**Pair Production**
Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)
**IONIC REACTIONS**
*See CHEMICAL REACTIONS*
**IONIZATION CALORIMETERS**
*See SHOWER COUNTERS*
**IONIZATION CHAMBERS**
**Design**
Electrodeless drift chambers with 50-CM drift distance, 12:37575 (BA;US)
**IONIZING RADIATIONS**
*See also COSMIC RADIATION*
*GAMMA RADIATION*
**Stimulated Emission**
Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986, 12:37473 (R;US)
**Tuning**
Demonstration of the feasibility of the tuning and stimulation of nuclear radiation. Annual summary report, 1 January-31 December 1986, 12:37473 (R;US)
**ION-MOLECULE COLLISIONS**
**Mass Spectroscopy**
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+$ ($^2P$/sub 3/2/) + Ar($^1S_0$) and $Ar^+$ ($^2P$/sub 3/2/) + $N_2$(X,v = 0), 12:38097 (D;US)
**IONOSPHERE**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**Dynamics**
Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986, 12:38086 (R;US)
**Electrodynamics**
Magnetosphere-ionosphere interaction studies. Final report, 11 July 1980-30 June 1984, 12:38083 (R;US)
Retarding potential analyzer research. Semiannual report, 1 July-31 December 1986, 12:38087 (R;US)
**Heating**
Preliminary investigation of ionospheric modifucation using oblique-incidence high-power h-f (high-frequency) radio waves. Technical report, 12:38082 (R;US)
**Magnetic Storms**
VLA (Very Large Array) observations of a solar-noise storm, 12:38055 (R;US)
**Modifications**
Preliminary investigation of ionospheric modifucation using oblique-incidence high-power h-f (high-frequency) radio waves. Technical report, 12:38082 (R;US)
**Variations**
Middle atmosphere density and models. Technical report, 12:38080 (R;US)
**IONS (MOLECULAR)**
*See MOLECULAR IONS*
**IRIDIUM 191 TARGET**
**Triton Reactions**
Ir(t-arrow-right,α)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)
**IRIDIUM 193 TARGET**
**Triton Reactions**
Ir(t-arrow-right,α)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)
**IRIDIUM ALLOYS**
**Chemical Preparation**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Crystal Defects**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Kondo Effect**
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
**Neutron Diffraction**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**X-Ray Diffraction**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**IRON**
**Band Theory**
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**Catalytic Effects**
Activation and promotion studies in a mixed slurry reactor with an iron-manganese Fischer-Tropsch catalyst, 12:37412 (J;US)
Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 17 October 1986 to 31 January 1987, 12:36582 (R;US)
**Magnetic Properties**
Magneto-optical studies of ultra-thin epitaxial films of fcc Fe on Cu(100), 12:37216 (R;US)
**Paramagnetism**
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**Sputtering**
Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals, 12:38296 (R;US)
**IRON 57 TARGET**
**Lithium 6 Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**IRON ALLOYS**
*See also INCONEL 600*
*IRON BASE ALLOYS*
**Fracture Properties**
Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)
**Magnetic Properties**
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)
**Microstructure**
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**Optical Properties**
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**IRON BASE ALLOYS**
*See also STEELS*
**Corrosion**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
**Ion Implantation**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
**Oxidation**
The eeffect of Y ion implantation on the oxide growth kinetics in Fe-24Cr, 12:37203 (R;US)
**Passivation**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
**IRON COMPLEXES**
**Catalytic Effects**
The testing of catalysts for alkane activation, 12:36600 (R;US)
**IRON IONS**
**Near Infrared Radiation**
Procedures for reduction of Fe XII 10747 A coronal emission-line polarization observations. Technical note, 12:38064 (R;US)
**IRON OXIDES**
*See also MAGNETITE*
**Catalytic Effects**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)
**IRON SILICIDES**
**Magnetic Properties**
Magnetism of MnSi and FeSi, 12:37328 (R;US)
**Magnetism**
Temperature-induced magnetism in FeSi, 12:37249 (J;US)
**Thermomagnetism**
Temperature-induced magnetism in FeSi, 12:37249 (J;US)
**IRON SULFATES**
**Hydrometallurgy**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Solvent Extraction**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**IRON SULFIDES**
*See also PYRITE*
**Catalytic Effects**
Disposable catalysts in coal liquefaction, 12:36282 (BA;NL)
**IRRIGATION**
**Energy Conservation**
Lost conservation opportunities in the Pacific Northwest irrigation sector, 12:37148 (R;US)
**ISABELLE**
*See ISABELLE STORAGE RINGS*
**ISABELLE STORAGE RINGS**
**Experiment Planning**
High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
**Operation**
High energy physics at Brookhaven National Lab., 12:37539 (BA;US)
**ISOBUTANE**
*See 2-METHYLPROPANE*
**ISOCYANATES**
**Indoor Air Pollution**
Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)
**ISOMERIZATION**
**Catalysis**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**ISOPENTANE**
*See 2-METHYLBUTANE*
**ITALY**
**Energy Policy**
Feasibility study about a National Integrated Informative System in the energy field. Results of a research on the national real demand of energetic information, 12:36980 (R;IT;In Italian)
**Information Systems**
Feasibility study about a National Integrated Informative System in the energy field. Results of a research on the national real demand of energetic information, 12:36980 (R;IT;In Italian)
**Textile Industry**
Approach to a more rational use of energy in the textile area of Prato. Diffusion proposals and operative indications of intervention, 12:37141 (R;IT;In Italian)

## J

**J-3105 RESONANCES**
*See PSI-3105 RESONANCES*
**JAILS**
*See PUBLIC BUILDINGS*
**JAPAN**
**Air Pollution Abatement**
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
**Environmental Policy**
Publications on environmental policy in Japan, 12:36961 (R;DE;In German)
**Prefabricated Buildings**
Japan's manufactured housing capability: a review of the industry and assessment of future impact on the US market, 12:37055 (RA;US)
**JET ENGINE FUELS**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**JETS**
**Dynamics**
Dynamic behavior of reacting gas jets submerged in liquids, 12:37390 (R;US)
**JOSEPHSON JUNCTIONS**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
**Instability**
Amplitude calculation near a period-doubling bifurcation: An example, 12:37470 (J;US)
**JOULE HEATING**
**B Codes**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)
**Confinement Time**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)
**Temperature Gradients**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)
**Thermal Diffusivity**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)

**JUNIPERUS**
*See CEDARS*

## K

**K01**
*See KAONS NEUTRAL SHORT-LIVED*
**K02**
*See KAONS NEUTRAL LONG-LIVED*
**K-25 PLANT**
*See ORGDP*
**KALE**
**Plant Growth**
Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)
**KAON MINUS-PROTON INTERACTIONS**
**Particle Production**
New results on mesons containing strange quarks, 12:38140 (RA;US)
**KAONS 1**
*See KAONS NEUTRAL SHORT-LIVED*
**KAONS 2**
*See KAONS NEUTRAL LONG-LIVED*
**KAONS MINUS**
**Weak Hadronic Decay**
How to measure $\epsilon'/\epsilon$ with lattice QCD, 12:38224 (R;US)
**KAONS NEUTRAL LONG-LIVED**
**Radiative Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**Semileptonic Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**Weak Hadronic Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**KAONS NEUTRAL SHORT-LIVED**
**Radiative Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**Semileptonic Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
**Weak Hadronic Decay**
CERN neutral kaon CP violation experiment NA31, 12:38144 (RA;US)
CP violation in K-short decay, 12:38143 (RA;US)
**KARLSRUHE NUCLEAR RESEARCH CENTER**
*See KERNFORSCHUNGSZENTRUM KARLSRUHE*
**KERNFORSCHUNGSZENTRUM KARLSRUHE**
**Coordinated Research Programs**
Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. April 1986-September 1986, 12:38381 (R;DE)
**Nuclear Physics**
Annual report on nuclear physics activities. July 1, 1985-June 30, 1986, 12:38231 (R;DE)
**Thermonuclear Reactors**
Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. April 1986-September 1986, 12:38381 (R;DE)
**KEROSENE**
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**KETONES**
*See also CAMPHOR*
**Chemical Preparation**
Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)
**Detection**
An intelligent thick-film gas sensor: development and preliminary tests, 12:37378 (R;US)
**KEVLAR**
*See ARAMIDS*
**KICKER MAGNETS**
**Pulse Circuits**
Some fast beam kicker magnet systems at SLAC, 12:37554 (R;US)
**KILNS**
**Heat Recovery**
Low temperature heat recovery, 12:37104 (R;GB)
**KLYSTRONS**
**Computerized Simulation**
Design of a wiggler-focused, sheet beam X band klystron, 12:37557 (R;US)
**Design**
Design of a wiggler-focused, sheet beam X band klystron, 12:37557 (R;US)
**Wiggler Magnets**
Design of a wiggler-focused, sheet beam X band klystron, 12:37557 (R;US)
**KNOWLEDGE BASE**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)
**KRYPTON 86 REACTIONS**
**Deep Inelastic Heavy Ion Reactions**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)

## L

**LABELLED COMPOUNDS**
*Compounds labelled with either stable or radioactive isotopes.*
*See also RADIOPHARMACEUTICALS*
**Biosynthesis**
Characteristics of the formation of enzyme-bound ATP from medium inorganic phosphate by mitochondrial $F_1$ adenosinetriphosphatase in the presence of dimethyl sulfoxide, 12:37866 (J;US)
**LABORATORY ANIMALS**
Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)
**LACTOSE**
**Anaerobic Digestion**
Methane production from lactose via defined mixed cultures of bacteria, 12:36631 (R;DE;In German)
**LAGUNA VERDE-1 REACTOR**
*Alto Lucero, Veracruz, Mexico*
**Construction**
Status of the Mexican nuclear power program, 12:36886 (RA;US)
**Reactor Safety**
Status of the Mexican nuclear power program, 12:36886 (RA;US)
**LAGUNA VERDE-2 REACTOR**
**Construction**
Status of the Mexican nuclear power program, 12:36886 (RA;US)
**Reactor Safety**
Status of the Mexican nuclear power program, 12:36886 (RA;US)
**LAKES**
*See also GREAT LAKES*
**Acidification**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)
**LAMBDA 2282 RESONANCES**
*See LAMBDA C PLUS*

**LAMBDA C PLUS**
*Prior to Jan. 1985 this information was indexed with the descriptor Lambda-2250 Resonances.*
**Weak Hadronic Decay**
Nonleptonic decays of a charmed baryon in the generalized chiral Lagrangian method, 12:38206 (TG;DE)
**LAMBDA NEUTRAL**
*See LAMBDA PARTICLES*
**LAMBDA PARTICLES**
**Particle Production**
Measurement of the ratio of Σ0 to $\Lambda^0$ inclusive production from 28.5-GeV/c protons on beryllium, 12:38151 (J;US)
**LAMBDA-2250 RESONANCES**
*See LAMBDA C PLUS*
**LAMBDA-2260 RESONANCES**
*See LAMBDA C PLUS*
**LAMINAR FLOW**
**Algorithms**
Algorithm implementation on the Navier-Stokes computer, 12:37495 (R;US)
**Computer Calculations**
Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)
**Mathematical Models**
Numerical solutions for laminar flow over a backward-facing step, 12:38104 (R;US)
**LAMINOGRAPHY**
*See TOMOGRAPHY*
**LAND APPLICATION**
*See GROUND DISPOSAL*
**LAND FILLS**
*See SANITARY LANDFILLS*
**LAND POLLUTION**
**Manuals**
Environmental Assessment Technical Assistance Handbook, 12:36964 (R;US)
**Risk Assessment**
Risk assessment of soil contamination criteria, 12:37821 (R;US)
**LAND RECLAMATION**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**Field Tests**
Reclamation of borrow pits and denuded lands: Final report, September 1, 1976 to December 31, 1985, 12:37765 (R;US)
**LANDFILLS**
*See SANITARY LANDFILLS*
**LANDSLIDES**
**Isotope Dating**
Dating landslides in Hudson Bay area, Quebec, 12:38023 (RA;US)
**LANGMUIR OSCILLATIONS**
*See PLASMA WAVES*
**LANTHANIDES**
*See RARE EARTHS*
**LANTHANUM CHROMITES**
*See LANTHANUM OXIDES*
**LANTHANUM COMPOUNDS**
*See also LANTHANUM NITRATES*
*LANTHANUM OXIDES*
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**LANTHANUM NITRATES**
**Osmosis**
Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C, 12:37423 (J;US)
**Solubility**
Osmotic and activity coefficients of aqueous La(NO/sub 3/)/sub 3/ and densities and apparent molal volumes of aqueous Eu(NO/sub 3/)/sub 3/ at 25°C, 12:37423 (J;US)
**LANTHANUM OXIDES**
**Band Theory**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Microstructure**
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
**Superconductivity**
Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/$CuO_4$, 12:37291 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Transition Temperature**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**LASER ISOTOPE SEPARATION**
**Lasers**
An overview of copper-laser development for isotope separation, 12:36481 (R;US)
**LASER MATERIALS**
**Garnets**
Growth of garnet crystals for laser applications. Final report, 1 February-31 July 1984, 12:37485 (R;US)
**LASER MIRRORS**
**Computer-Aided Design**
Optical analysis of high power free electron laser resonators, 12:37484 (R;US)
**LASER RADIATION**
**Charged-Particle Reactions**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
**Health Hazards**
Laser Hazards Bibliography (12th Edition), 12:38011 (R;US)
**LASER SPECTROSCOPY**
*See also RAMAN SPECTROSCOPY*
**Performance Testing**
In situ real-time analysis of particulates, 12:36355 (RA;US)
**LASER TARGETS**
**Coatings**
Radiographic detection of 100 a thickness variations in 1-μm-thick coatings on submillimeter-diameter laser fusion targets, 12:38389 (BA;US)
**Energy Absorption**
Near spherical illumination of ion-beam and laser targets, 12:38384 (R;US)
**S Codes**
An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
**LASER WEAPONS**
**Arms Control**
Safeguarding our military space systems, 12:37190 (J;US)
**LASER-PRODUCED PLASMA**
**Focusing**
On relativistic self focusing, 12:38387 (J;GB)
**Refractivity**
On relativistic self focusing, 12:38387 (J;GB)
**LASERS**
*Light Amplification by Stimulated Emission of Radiation.*
*See also FREE ELECTRON LASERS*
*SOLID STATE LASERS*
*X-RAY LASERS*
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**Amplitudes**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)
**Cost Benefit Analysis**
Multimegajoule laser design (Glass lasers), 12:37486 (R;US)
**Design**
Multimegajoule laser design (Glass lasers), 12:37486 (R;US)
**Dielectric Materials**
Minimum inductance laser head for pulsed transverse discharges without wall tracking, 12:37490 (P;US)

**Electric Discharges**
Minimum inductance laser head for pulsed transverse discharges without wall tracking, 12:37490 (P;US)
**Electrodes**
Minimum inductance laser head for pulsed transverse discharges without wall tracking, 12:37490 (P;US)
**Electro-Optical Effects**
Electro-optical modulator for an electro-optically modulated laser, 12:37489 (P;US)
**Modulation**
Electro-optical modulator for an electro-optically modulated laser, 12:37489 (P;US)
**Molecular Structure**
Materials depositions produced by laser radiation, 12:37481 (R;IT;In Italian)
**Pulses**
Picosecond studies of multiphoton absorption: Final technical report, 12:37395 (R;US)

**LASL**
**Chemical Effluents**
Environmental surveillance at Los Alamos during 1986, 12:37711 (R;US)
**Monitoring**
Environmental surveillance at Los Alamos during 1986, 12:37711 (R;US)
**Nuclear Materials Management**
The R and D/operational MC and A [materials control and accounting] interface (Materials control and accounting), 12:36560 (R;US)
**Radioactive Effluents**
Environmental surveillance at Los Alamos during 1986, 12:37711 (R;US)

**LATTICE FIELD THEORY**
**Algorithms**
Monte Carlo algorithms for lattice gauge theory, 12:38215 (R;US)
**Computerized Simulation**
Research program in computational physics: [Progress report for Task D], 12:38159 (R;US)
**Fermions**
Unorthodox lattice fermion derivatives and their shortcomings, 12:38214 (R;US)

**LATTICES (CRYSTAL)**
*See CRYSTAL LATTICES*

**LAWRENCE LIVERMORE LABORATORY**
**Environment**
Tritium in groundwater at Site 300, 12:37853 (R;US)
**Nuclear Weapons**
Arms control activities in LLNL, 12:37195 (J;US)
Laboratory and arms control, 12:37188 (J;US)
**Plants**
Vegetation of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California, 12:37828 (R;US)
**Research Programs**
Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87, 12:37197 (R;US)
Engineering Research Division publication report, Calendar year 1986, 12:37447 (R;US)
**Security**
The Livermore Security Console system, 12:36572 (R;US)

**LD 50**
*See LETHAL RADIATION DOSE*

**LEACHATES**
**Waste Water**
Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)

**LEAD**
**Dusts**
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
**Uptake**
Uptake and distribution of heavy metals in annelidae, with particular regard to limnic tubificides (oligochaeta), 12:37987 (R;DE;In German)
**Water Pollution**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)

**LEAD 208**
**Giant Resonance**
Photon decay of giant resonances, 12:38263 (BA;DE)

**LEAD 208 TARGET**
**Krypton 86 Reactions**
Excitation energy sharing in /sup 86/Kr-induced quasielastic reactions on /sup 197/Au and /sup 208/PB between 10 and 18.2 MeV/u, 12:38260 (R;DE)
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**LEAD 210**
**Biological Effects**
Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)
**Membrane Transport**
Effects of calmodulin inhibitors on the cellular metabolism of $^{45}Ca$ and $^{210}Pb$, 12:37937 (R;US)

**LEAD 212**
**Diffusion**
Diffusivity study of free thoron decay products by deposition measurement on cylindrical tubes and screens, 12:37713 (RA;US)

**LEAD ALLOYS**
**Structure Factors**
Structure of liquid equiatomic potassium—lead alloy: A neutron diffraction experiment, 12:37246 (J;US)

**LEAD COMPOUNDS**
*See also LEAD OXIDES*
*LEAD PHOSPHATES*
*PZT*
**Acidification**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Electrical Properties**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Fabrication**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Gelation**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Hydrolysis**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Sol-Gel Process**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Structural Chemical Analysis**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)

**LEAD OXIDES**
**Reduction**
PbO reduction and crucible reactions of PbO . 30 wt % $B_2O_3$ glass, 12:37302 (R;US)

**LEAD PHOSPHATES**
**Crystallization**
Structural nature of the amorphous-to-crystalline transition in phosphate glasses as studied by liquid chromatography, 12:37331 (R;US)

**LEAD ZIRCONITE TITANATE**
*See PZT*

**LEAD-FREE GASOLINE**
*See UNLEADED GASOLINE*

**LEAK DETECTORS**
**Technology Utilization**
Improving infiltration control techniques in low income weatherization, 12:37056 (RA;US)

**LEAVES**
**Chemical Composition**
Mathematical and statistical evaluations of needle analyses, 12:37941 (RA;DE;In German)
**Spectral Reflectance**
Spectral signatures of damaged spruce stands measured from a helicopter, 12:37772 (RA;DE)
**LEGUMINOSAE**
**Plant Growth**
Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)
**LEPTON-DEUTERON INTERACTIONS**
*See DEUTERIUM TARGET*
**LEPTONS**
*See also HEAVY LEPTONS*
*MUONS*
*NEUTRINOS*
**Composite Models**
Compositeness below 1 TeV, 12:38194 (RA;US)
**Excited States**
Excited lepton search, 12:38116 (R;DE)
**Pair Production**
Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories, 12:38164 (R;US)
Limits on likesign dilepton production in $\nu$/sub $\mu$/ interactions, 12:38243 (BA;US)
Massive lepton pair production - the Drell-Yan process - with nuclear targets, 12:38282 (BA;DE)
**Polarization-Asymmetry Ratio**
Leptonic polarization asymmetries at $e^+e^-$ colliders in $E_6$ theories, 12:38164 (R;US)
**LETHAL RADIATION DOSE**
*Referring to a percentage kill, frequently with a time indication.*
**Mathematical Models**
Prediction of the mortality dose-response relationship in man, 12:37901 (R;US)
**LETTUCE**
**Production**
Alternative energy supply systems for lettuce production in greenhouses, 12:37145 (R;NO;In Norwegian)
**LEUCOCYTES**
*See LEUKOCYTES*
**LEUKOCYTES**
*See also LYMPHOCYTES*
*NEUTROPHILS*
**Biological Radiation Effects**
Metabolic effects of microwave radiation and convection heating on human mononuclear leukocytes. Final report, January 1985-May 1986, 12:38012 (R;US)
**LIBERIA**
**Deforestation**
Forestry and forest industries in Liberia. An example in ecological destabilization, 12:37897 (R;DE)
**Forests**
Forestry and forest industries in Liberia. An example in ecological destabilization, 12:37897 (R;DE)
**LIGASES**
*Code number 6.*
**Enzyme Activity**
Self-protection of Pseudomonas syringae pv. tabaci from its toxin, tabtoxinine-$\beta$-lactam, 12:37881 (J;US)
**LIGHT**
*See VISIBLE RADIATION*
**LIGNIN**
**Acid Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**Enzymatic Hydrolysis**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)
**Pyrolysis**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
**LIGNITE**
**Biodegradation**
Microbial screening test for lignite degradation: Quarterly progress report No. 10 for the period April-June 1987, 12:36311 (R;US)
**Chemical Analysis**
New approaches to the characterization of lignites: a combined geological and chemical study, 12:36323 (BA;NL)
**Combustion Products**
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Ion Exchange**
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**Macerals**
Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin, 12:36294 (R;US)
**Modifications**
Microbial screening test for lignite degradation: Quarterly progress report No. 10 for the period April-June 1987, 12:36311 (R;US)
**LIMITERS**
**Degassing**
Impurity and particle transport and control in TFTR, 12:38382 (R;US)
**LINACS**
*See LINEAR ACCELERATORS*
**LINEAR ACCELERATORS**
*See also CEBAF ACCELERATOR*
*ORELA*
*STANFORD LINEAR COLLIDER*
**Beam Dynamics**
Tranverse beam break up in a periodic linac, 12:37540 (R;US)
**LINEAR MOMENTUM**
**Momentum Transfer**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**LINEAR Z PINCH DEVICES**
**Plasma Instability**
High density Z pinch formed from a solid deuterium fiber, 12:38340 (R;US)
**LIQUEFIED PETROLEUM GASES**
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**LIQUID ASPHALT**
*See PETROLEUM RESIDUES*
**LIQUID COLUMN CHROMATOGRAPHY**
**Performance Testing**
Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high molecular weight coal components, 12:36301 (RA;US)
**LIQUID CRYSTALS**
**NMR Spectra**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**LIQUID FUELS**
*See also FUEL OILS*
*GASOLINE*
*KEROSENE*

**Chemical Composition**
Product analysis from direct liquefaction of several high-moisture biomass feedstocks, 12:36591 (R;US)
**Chemical Preparation**
Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)
**Combustion Kinetics**
Theoretical and experimental investigations of ignition, combustion and expansion processes of hypergolic liquid fuel combinations at gas temperatures up to 3000 deg K. Thesis - Rhein-Westfalia Technical Coll., 1967, 12:37441 (R;US)
Theoretical study of the nonsteady combustion of composite fuel droplets, 12:37446 (TG;FR)

**LIQUID METAL COOLANT**
*See LIQUID METALS*

**LIQUID METAL TEST FACILITIES**
*See TEST FACILITIES*

**LIQUID METALS**
The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)
**Density**
On the role of density fluctuations in the entropy of a fluid, 12:38311 (J;US)
**Entropy**
On the role of density fluctuations in the entropy of a fluid, 12:38311 (J;US)
**Structure Factors**
Structure of liquid equiatomic potassium—lead alloy: A neutron diffraction experiment, 12:37246 (J;US)

**LIQUIDS**
*See also COAL LIQUIDS*
*LIQUID CRYSTALS*
*LIQUID METALS*
*NATURAL GAS LIQUIDS*
**Cementing**
Design of saltstone vaults (Radioactive), 12:36512 (R;US)
**Thermal Conductivity**
Thermal conductivities of ternary liquid mixtures, 12:37420 (J;US)

**LITHIUM 7**
**Hypernuclei**
Electromagnetic transitions in hypernuclei, 12:38242 (BA;DE)

**LITHIUM COMPOUNDS**
*See also LITHIUM OXIDES*
*LITHIUM SILICATES*
**Titanates**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)

**LITHIUM OXIDES**
**Chemical Preparation**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)
**Gelation**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)
**Plasticity**
Deformation of polycrystalline $Li_2O$, 12:37306 (J;NL)
**Structural Chemical Analysis**
Polymer growth and gelation in borate-based systems, 12:37316 (BA;US)

**LITHIUM SILICATES**
**Mechanical Properties**
Advanced composite combustor structural concepts program. Final Report, 12:37343 (R;US)

**LIVER**
**Necrosis**
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)
**Neoplasms**
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
**Radiation Doses**
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
**Radionuclide Kinetics**
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)

**LMFBR TYPE REACTORS**
*See also EBR-2 REACTOR*
**Heterogeneous Reactor Cores**
Demonstration of a high burnup heterogeneous core using ferritic/martensitic materials, 12:36783 (R;US)

**LNG SPILLS**
*See GAS SPILLS*

**LOAD MANAGEMENT**
**Time-of-Use Pricing**
Switching-off power loads in industry, 12:36998 (R;DK;In Danish)

**LOCA**
*See LOSS OF COOLANT*

**LOCAL GALAXY**
*See MILKY WAY*

**LOCKS (SECURITY)**
*See PHYSICAL PROTECTION DEVICES*

**LONGITUDINAL PINCH DEVICES (LINEAR)**
*See LINEAR Z PINCH DEVICES*

**LONGWALL MINING**
**Technology Assessment**
Thick-seam mining in the Western United States--geological considerations. Information Circular/1986, 12:36343 (R;US)

**LOS ALAMOS SCIENTIFIC LABORATORY**
*See LASL*

**LOS ANGELES**
**Air Pollution Monitoring**
Identification of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate in the Los Angeles atmosphere, 12:37645 (R;US)
**Energy Balance**
Undoing uncomfortable summer heat islands can save gigawatts of peak power, 12:37029 (RA;US)

**LOSS OF COOLANT**
**Heat Transfer**
Analysis results from the Los Alamos 2D/3D program, 12:36863 (RA;US)
Comparison of a TRAC calculation to the data from LSTF run SB-CL-05, 12:36849 (RA;US)
Development of reflood model at JAERI, 12:36861 (RA;US)
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
Heat transfer enhancement in SCTF tests, 12:36860 (RA;US)
Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
PWR recovery procedures investigated in the LOBI-MOD2 test facility, 12:36842 (RA;US)
Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)
SCTF-III test plan and recent SCTF-III test result, 12:36859 (RA;US)
Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system, 12:36846 (RA;US)
Summary of CCTF test results, 12:36858 (RA;US)
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)

Two-phase flow measurement in the upper plenum of a PWR during reflood, 12:36851 (RA;US)
**Hydraulics**
Analysis results from the Los Alamos 2D/3D program, 12:36863 (RA;US)
Comparison of a TRAC calculation to the data from LSTF run SB-CL-05, 12:36849 (RA;US)
Development of reflood model at JAERI, 12:36861 (RA;US)
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
Heat transfer enhancement in SCTF tests, 12:36860 (RA;US)
Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
PWR recovery procedures investigated in the LOBI-MOD2 test facility, 12:36842 (RA;US)
Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)
SCTF-III test plan and recent SCTF-III test result, 12:36859 (RA;US)
Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
Small-break loss of coolant accident (SBLOCA) test results from the multiloop integral system test (MIST) facility, 12:36844 (RA;US)
Small break loss of coolant test results for UMCP 2 x 4 loop one- and two-phase natural circulation in multi-loop system, 12:36846 (RA;US)
Summary of CCTF test results, 12:36858 (RA;US)
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)
Two-phase flow measurement in the upper plenum of a PWR during reflood, 12:36851 (RA;US)
**Natural Convection**
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
**T Codes**
TRAC-PF1/MOD1 pretest predictions of MIST experiments, 12:36845 (RA;US)
**Test Facilities**
Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
**Two-Phase Flow**
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
**LOST CIRCULATION**
**Research Programs**
Research in lost circulation control for geothermal wells, 12:36726 (R;US)
**LOUISIANA**
**Paleoclimatology**
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
**LOW-BETA PLASMA**
*Beta from 0 to 0.01.*
**Ballooning Instability**
Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
**Stability**
Low beta rigid mode stability criterion for an arbitrary Larmor radius plasma, 12:38334 (R;US)
**LOW-LEVEL RADIOACTIVE WASTES**
**Grouting**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Leaching**
Accelerated Leach Test(s) Program: Annual report, 12:36500 (R;US)
**Processing**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Radioactive Waste Disposal**
Considerations on a de minimis dose and disposal of exempt concentrations of radioactive wastes, 12:36525 (R;US)
Pilot-scale grout production test with a simulated low-level waste, 12:36527 (R;US)
**Radioactive Waste Management**
F-Area Seepage Basins: Environmental information document, 12:37826 (R;US)
**Radioactive Waste Processing**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**Solidification**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
Pilot-scale grout production test with a simulated low-level waste, 12:36527 (R;US)
**Underground Disposal**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**LP-GAS**
*See LIQUEFIED PETROLEUM GASES*
**LUBRICANTS**
**Performance Testing**
Lubication and surface finish of extruded aluminum, 12:37218 (R;US)
**LUMINESCENT CONCENTRATORS**
**Design**
Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)
**Efficiency**
Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)
**Research Programs**
Luminescent solar concentrator development: Final subcontract report, 1 June 1982-31 December 1984, 12:36705 (R;US)
**LUNG CLEARANCE**
**Mathematical Models**
Model analysis of respiratory tract clearance of particles inhaled by people, 12:37970 (RA;US)
**LUNGS**
**Carcinomas**
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
**Chemical Composition**
Alterations of bronchoalveolar lavage cytology in cynomolgus monkeys after sequential saline lavages, 12:37869 (RA;US)
Trace element analyses in order to determine heavy metal concentrations in lung tissues. A contribution to an objective assessment of occupational hazards, 12:37985 (R;DE;In German)
**Dynamic Function Studies**
Cardiopulmonary function of dogs with plutonium-induced chronic lung injury, 12:37924 (RA;US)
Cross-sectional study of the effects of age on pulmonary function and lung morphology of Beagle dogs, 12:37887 (RA;US)
Effects of body position on pulmonary function of the F344/N rat, 12:37886 (RA;US)
Work performance evaluation using the exercising rat model, 12:37959 (R;US)
**Fibrosis**
Cardiopulmonary function of dogs with plutonium-induced chronic lung injury, 12:37924 (RA;US)
Effect of time of glutathione depletion on ozone-induced pulmonary fibrosis, 12:37975 (RA;US)
Possible role of reduced glutathione in the development of pulmonary fibrosis, 12:37974 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)

Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII, 12:37921 (RA;US)
**Immune Reactions**
Histopathology of secondary immune responses in the primate lung, 12:37884 (RA;US)
**Lavage**
Alterations of bronchoalveolar lavage cytology in cynomolgus monkeys after sequential saline lavages, 12:37869 (RA;US)
**Neoplasms**
Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. II, 12:37925 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX, 12:37919 (RA;US)
**Radiation Doses**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}Ce$. XII, 12:37916 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble form by Beagle dogs XIX, 12:37913 (RA;US)
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 μ AMAD particles. B. Monodisperse 3.0 μm particles. XIII, 12:37918 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX, 12:37919 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII, 12:37921 (RA;US)
**Radionuclide Kinetics**
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)
**Sensitivity**
Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)
Lung cellular response and lymphocyte blastogenesis, 12:37973 (RA;US)

**LWBR TYPE REACTORS**
**Fuel Rods**
Final report for the Light Water Breeder Reactor proof-of-breeding analytical support project, 12:36782 (R;US)

**LYMANTRIA DISPAR**
**Insecticides**
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)

**LYMPH NODES**
**Carcinomas**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}Ce$. XII, 12:37916 (RA;US)
**Neoplasms**
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
**Radionuclide Kinetics**
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)
**Sarcomas**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}Ce$. XII, 12:37916 (RA;US)

**LYMPHOCYTES**
**Cell Proliferation**
Lung cellular response and lymphocyte blastogenesis, 12:37973 (RA;US)

**LYMPHOID CELLS**
*See LYMPHOCYTES*

## M

**MA 754**
*See NICKEL BASE ALLOYS*

**MA 956**
*See IRON BASE ALLOYS*

**MACERALS**
**Molecular Structure**
Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin, 12:36294 (R;US)
**Structural Chemical Analysis**
Chemical structure of a sporinite from a lignite: Comparison with a synthetic sporinite transformed from sporopollenin, 12:36294 (R;US)

**MACHINING**
*See also CUTTING*
*MILLING*
**Hazardous Materials**
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)

**MACROPHAGES**
**Phagocytosis**
Cytotoxicity of beryllium compounds to cultured canine alveolar macrophages, 12:37972 (RA;US)
**Viability**
Cytotoxicity of beryllium compounds to cultured canine alveolar macrophages, 12:37972 (RA;US)

**MAGMAMAX PROCESS**
*See BINARY-FLUID SYSTEMS*

**MAGNESIUM**
**Cladding**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)

**MAGNESIUM ALLOYS**
**Corrosion Resistance**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)

**MAGNESIUM CHLORIDES**
**Activation Energy**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)
**Density**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Free Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Osmosis**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)

**Specific Heat**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Vapor Pressure**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)

**MAGNESIUM OXIDES**
*See also SPINELS*
**Catalytic Effects**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Superconducting Junctions**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)

**MAGNETIC BREMSSTRAHLUNG**
*See SYNCHROTRON RADIATION*

**MAGNETIC FIELDS**
*See also GEOMAGNETIC FIELD*
**Augmentation**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)
**Plasma Drift**
Limits on the cross-field propagation of streams of cold plasma, 12:38360 (J;US)
**Superconducting Coils**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)

**MAGNETIC FLUX**
**Annihilation**
Annihilation of vortex-antivortex pairs in a superconducting shield, 12:37458 (R;US)

**MAGNETIC MONOPOLES**
**Electromagnetic Interactions**
Are the Dirac strings harmless?, 12:38317 (BA;US)
**Particle Production**
New stable charged particles, 12:38181 (RA;US)

**MAGNETIC SHIELDING**
Annihilation of vortex-antivortex pairs in a superconducting shield, 12:37458 (R;US)

**MAGNETIC STORMS**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
**Forecasting**
Forecasts of solar and geomagnetic activity, 12:38059 (RA;US)

**MAGNETIC VORTICES**
*See MAGNETIC FLUX*

**MAGNETITE**
**Fluidized Beds**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Particle Size**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)

**MAGNETOHYDRODYNAMIC GENERATORS**
*See MHD GENERATORS*

**MAGNETOHYDRODYNAMICS**
**Research Programs**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)

**MAGNETOSPHERE**
*See EARTH MAGNETOSPHERE*

**MAGNETOTAIL**
**Ion Beams**
Generation of broadband noise in the magnetotail, 12:38081 (R;US)

**MAGNETRONS**
**Electric Discharges**
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)

**MAHOGANY TREES**
*See TREES*

**MAINTENANCE**
**Optimization**
Safety and optimal prevention of platform accidents, 12:36413 (R;NO)

**MAINTENANCE FACILITIES**
**Hazardous Materials**
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)

**MALIGNANCIES**
*See NEOPLASMS*

**MAMMARY GLANDS**
**Carcinomas**
Radium-dial workers, 12:37935 (BA;US)

**MAN**
*All of mankind, of any age or of either sex.*
**Aerosols**
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
**Air Quality**
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
**Behavior**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
**Radiation Injuries**
Prediction of the mortality dose-response relationship in man, 12:37901 (R;US)
**Thermal Comfort**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)

**MANGANESE**
**Catalytic Effects**
Activation and promotion studies in a mixed slurry reactor with an iron-manganese Fischer-Tropsch catalyst, 12:37412 (J;US)
**Water Pollution**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)

**MANGANESE ALLOYS**
**Melting Points**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)
**Phase Studies**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)

**MANGANESE COMPLEXES**
**Catalytic Effects**
The testing of catalysts for alkane activation, 12:36600 (R;US)

**MANGANESE SILICIDES**
**Magnetic Properties**
Magnetism of MnSi and FeSi, 12:37328 (R;US)

**MANUFACTURED BUILDINGS**
*See PREFABRICATED BUILDINGS*

**MANUFACTURING FACILITIES**
*See INDUSTRIAL PLANTS*

**MANURES**
**Anaerobic Digestion**
Report on anaerobic digestion of dairy cattle wastes to October 1981, 12:36585 (R;GB)

**MANY-BODY PROBLEM**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)

**MAPLES**
**Plant Growth**
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)

**MARINE DISPOSAL**
Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo, 12:37842 (R;US)

**MARINE ECOSYSTEMS**
*See AQUATIC ECOSYSTEMS*

**MARINE VEHICLE ACCIDENTS**
*See ACCIDENTS*
**MARITIME TRANSPORT**
**Field Tests**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**MARKET**
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**MARKET SHARES**
*See MARKET*
**MARYLAND**
**Fossil-Fuel Power Plants**
Air-quality impact analysis for Easton Utilities Commission Power Plant No. 2, units 23 and 24. Final report, 12:36762 (R;US)
**Renewable Energy Sources**
Alternative energy sources guidebook. Final report, 12:37003 (R;US)
**Urban Areas**
Baltimore feeder-bus planning study. Final report, 12:37100 (R;US)
**MASS**
**Mathematical Models**
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
**R Codes**
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
**MASS SPECTRA**
**Libraries**
Comparison study of search algorithms and data base libraries for compound identification from mass spectral data, 12:37380 (R;US)
**MASS SPECTROMETERS**
**Calibration Standards**
Development of the NBS $^{10}Be/^{9}Be$ isotopic standard reference material, 12:37577 (R;US)
**MASS SPECTROSCOPY**
Present and future prospects of accelerator mass spectrometry, 12:37370 (R;US)
**Calibration**
Permeation tubes for dynamic mass spectrometry calibration, 12:37379 (R;US)
**Performance Testing**
Development and evaluation of supercritical fluid chromatography/mass spectrometry for polar and high molecular weight coal components, 12:36301 (RA;US)
**MASS TRANSIT SYSTEMS**
**Buses**
Baltimore feeder-bus planning study. Final report, 12:37100 (R;US)
**Financing**
Innovative financing for transportation: practical solutions and experiences. Final report, 12:37101 (R;US)
Non-federal funding for transit systems: state-of-the-art case analyses. Final report, 1983-1985, 12:37099 (R;US)
**Railways**
Baltimore feeder-bus planning study. Final report, 12:37100 (R;US)
**MASSACHUSETTS INSTITUTE OF TECHNOLOGY ALC**
*See ALCATOR DEVICE*
**MASSACHUSETTS INSTITUTE OF TECHNOLOGY REA**
*See MITR REACTOR*
**MASSIVE VECTOR-MESON MODEL**
*See GLUON MODEL*
**MATERIALS**
*See also BUILDING MATERIALS*
*COMPOSITE MATERIALS*
*HAZARDOUS MATERIALS*
*LASER MATERIALS*
*PHASE CHANGE MATERIALS*
*POROUS MATERIALS*
*RADIOACTIVE MATERIALS*
*REACTOR MATERIALS*
*SEMICONDUCTOR MATERIALS*
*THERMONUCLEAR REACTOR MATERIALS*
*TOXIC MATERIALS*
**Commercialization**
Enthusiasms and realities in advanced materials, 12:37196 (R;US)
**Porosity**
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**Research Programs**
Chemistry and Materials Science quarterly research report: Weapons-Supporting Research and departmental Institutional Research and Development: Second quarter FY87, 12:37197 (R;US)
**Ultimate Strength**
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**Ultrasonic Testing**
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**MATERIALS (BUILDING)**
*See BUILDING MATERIALS*
**MATERIALS (COMPOSITE)**
*See COMPOSITE MATERIALS*
**MATERIALS (FERROELECTRIC)**
*See FERROELECTRIC MATERIALS*
**MATERIALS (FERROMAGNETIC)**
*See FERROMAGNETIC MATERIALS*
**MATERIALS HANDLING EQUIPMENT**
*See also HOISTS*
**Computerized Control Systems**
United States Coast Guard portable salvage computer. Final report, 12:36956 (R;US)
**MATERIALS (POROUS)**
*See POROUS MATERIALS*
**MATERIALS RECOVERY**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**MATERIALS (SEMICONDUCTOR)**
*See SEMICONDUCTOR MATERIALS*
**MATHEMATICAL MODELS**
*See also ATOMIC MODELS*
*COSMOLOGICAL MODELS*
*FLOW MODELS*
*NUCLEAR MODELS*
**Sensitivity**
Dynamic behavior and control requirements of an atmospheric fluidized-bed coal combustion power plant: A conceptual study, 12:36362 (R;US)
**MEASURING INSTRUMENTS**
*Use of a more specific term is recommended.*
*See also ACCELEROMETERS*
*CALORIMETERS*
*RADIATION DETECTORS*
*SEISMIC ARRAYS*
*SPECTROMETERS*
*VISCOSIMETERS*
**Design**
Ash deposition sensor development, 12:36356 (RA;US)
High-precision, low-cost dendrochronograph, 12:37454 (RA;US)
Imaging and control instrumentation for studying the combustion behavior of single fuel droplets, 12:36359 (RA;US)
Method to obtain thin cross-sections for tree-ring analysis, 12:38036 (RA;US)
Physiological pH fiber-optic chemical sensor based on energy transfer (Eosin and phenol red), 12:37414 (J;US)
**Fabrication**
The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)
**Operation**
The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)
**Performance Testing**
Ash deposition sensor development, 12:36356 (RA;US)
Imaging and control instrumentation for studying the combustion behavior of single fuel droplets, 12:36359 (RA;US)

**Research Programs**
Opening remarks: instrumentation, components, and materials contractors meeting, 12:36242 (RA;US)
**MECHANICAL ENGINEERING**
**Research Programs**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
**MECHANICAL STRUCTURES**
*See also SUPPORTS*
**Seismic Effects**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**MECHANICAL TESTS**
*See also the properties tested.*
**Computerized Control Systems**
Random control at $n^2$ points using n shakers, 12:37508 (R;US)
**Mechanical Vibrations**
Random control at $n^2$ points using n shakers, 12:37508 (R;US)
**MECHANICAL TRANSMISSIONS**
**Comparative Evaluations**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)
**MECHANICAL VIBRATIONS**
**Computerized Control Systems**
Random control at $n^2$ points using n shakers, 12:37508 (R;US)
**MECHANICS**
*See also CLASSICAL MECHANICS*
*DYNAMICS*
*FLUID MECHANICS*
*QUANTUM MECHANICS*
**Finite Element Method**
Coupling boundary integral and finite element formulations for nonlinear halfspace problems, 12:38412 (R;US)
**MEDICAL CENTERS**
*See MEDICAL ESTABLISHMENTS*
**MEDICAL ESTABLISHMENTS**
*See also HOSPITALS*
**Hazardous Materials**
Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York, 12:37689 (R;US)
**MEDICAL RECORDS**
**Data Base Management**
Maintaining occupational review programs using the flow Gemini system, 12:37933 (R;US)
**MEDICINE**
**Bibliographies**
Biomedical and Environmental Sciences Programs: Publications 1986, 12:37859 (R;US)
**MEDICINES**
*See DRUGS*
**MELANOCYTES**
*See ANIMAL CELLS*
**MELTDOWN**
Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor, 12:36822 (R;DE;In German)
**MEMBRANES**
*See also MUCOUS MEMBRANES*
**Optimization**
Optimisation of a membrane cell cascade for chlorine alkali electrolysis under the aspect of energy consumption, 12:37405 (R;DE;In German)
**Uses**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**MERCAPTOALANINE-BETA**
*See CYSTEINE*
**MERCURY**
**Air Pollution Control**
Review of national emission standards for mercury (final environmental impact statement), 12:37650 (R;US)
**Environmental Exposure Pathway**
Mercury hazards to fish, wildlife, and invertebrates: a synoptic review, 12:37998 (R;US)
**Toxicity**
Mercury hazards to fish, wildlife, and invertebrates: a synoptic review, 12:37998 (R;US)
**MERCURY PLANET**
**Infrared Radiation**
Possible calorimetric effects at Mercury due to solar wind-magnetosphere interactions, 12:38072 (J;US)
**Planetary Magnetospheres**
Possible calorimetric effects at Mercury due to solar wind-magnetosphere interactions, 12:38072 (J;US)
**Solar Wind**
Possible calorimetric effects at Mercury due to solar wind-magnetosphere interactions, 12:38072 (J;US)
**MERCURY TELLURIDES**
**Crystal Growth**
Computational analyses of crystal growth. Final report, 12:37345 (R;US)
**MESON RESONANCES**
*See also UPSILON RESONANCES*
**Research Programs**
Experimental investigations of production of glueballs and meson resonant states, 12:38123 (R;US)
**MESON-DEUTERON INTERACTIONS**
*See DEUTERIUM TARGET*
**METAL BUILDINGS**
*See PREFABRICATED BUILDINGS*
**METAL INDUSTRY**
**Computerized Control Systems**
Experiences of computer control of heating processes at Avesta Jernverk, 12:37109 (RA;SE)
**Hazardous Materials**
Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
**Machining**
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
**METALLIC GLASSES**
**Annealing**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Electric Conductivity**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Microhardness**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Powder Metallurgy**
High-energy high-rate pulsed-power processing of materials by powder consolidation and by railgun deposition. Technical report (Final), 10 April 1985-10 February 1987, 12:37200 (R;US)
**Relaxation**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Stress Relaxation**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**METALS**
*See also ALKALI METALS*
*ALKALINE EARTH METALS*
*ALUMINIUM*
*CADMIUM*
*GALLIUM*
*GERMANIUM*
*LEAD*
*LIQUID METALS*
*MERCURY*
*RARE EARTHS*
*SCRAP METALS*
*TIN*
*TRANSITION ELEMENTS*
*ZINC*
**Adsorption**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Deformation**
Acoustic emission produced by deformation of metals and alloys, 12:37233 (R;US)

**Dislocations**
Anisotropic Schmid factors in constrained systems, 12:37260 (J;US)
**Energy Losses**
Energy dissipation in the scanning tunneling microscopy of metals and insulators, 12:37276 (BA;US)
**Environmental Exposure Pathway**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
**Grain Orientation**
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
**Heat Exchanger Method**
Anisotropic Schmid factors in constrained systems, 12:37260 (J;US)
**Land Pollution**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)
**Porosity**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
**Quantitative Chemical Analysis**
Trace element analyses in order to determine heavy metal concentrations in lung tissues. A contribution to an objective assessment of occupational hazards, 12:37985 (R;DE;In German)
**Recrystallization**
Estimates of incubation and completion times in recrystallization, 12:37259 (J;US)
**Removal**
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Shear Properties**
Anisotropic Schmid factors in constrained systems, 12:37260 (J;US)
**Superconductivity**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
**Texture**
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
**Thermodynamic Properties**
Thermal contact resistance in waste heat recovery systems, 12:37152 (BA;US)
**Tunnel Effect**
Tunneling from a self-energy approach, 12:37277 (BA;US)
**Ultrasonic Testing**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
**Uptake**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**Water Pollution**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)

**METHANATION**
**Chemical Reactors**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)

**METHANE**
**Anaerobic Digestion**
Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report, 12:36588 (R;US)
**Biosynthesis**
Methane production from lactose via defined mixed cultures of bacteria, 12:36631 (R;DE;In German)
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Chemical Analysis**
Gas chromatograph-based system for measuring the methane fraction of diesel-engine hydrocarbon emissions, 12:37635 (R;US)
**Chemical Preparation**
Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Fermentation**
Toxic substances in methane fermentation systems: fate and effect on process kinetics. Final report, 12:36588 (R;US)
**Fischer-Tropsch Synthesis**
Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling, 12:36595 (B;US)
**Gas Yields**
Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report, 12:36580 (R;DE;In German)
**Production**
Application of horizontal drainhole drilling technology for coalbed methane recovery, 12:36452 (BA;US)
**Reformer Processes**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Scrubbing**
Survey of existing methods of biogas scrubbing and utilisation, 12:36587 (R;GB)
**Uses**
Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report, 12:36580 (R;DE;In German)

**METHANOGENIC BACTERIA**
**Genetic Engineering**
Characterization of bromoethanesulfonate-resistant mutants of methanococcus voltae: evidence of a coenzyme M transport system, 12:37872 (J;US)
**Immunoassay**
Antigenic mosaic of Methanogenium spp.: analysis with poly- and monoclonal antibody probes, 12:37882 (J;US)
**Metabolism**
Characterization of bromoethanesulfonate-resistant mutants of methanococcus voltae: evidence of a coenzyme M transport system, 12:37872 (J;US)

**METHANOL**
**Decomposition**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Synthesis**
Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures, 12:36603 (R;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)

**METHYL ALCOHOL**
*See METHANOL*

**METHYL ETHER**
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)

**METHYL PHENOLS**
*See CRESOLS*

**METHYL RADICALS**
Molecular dynamics studies of energy transfer processes in crystal systems: Annual summary report (Nitromethyl Radicals), 12:38302 (R;US)

**Electric Impedance**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**Recombination**
Study of the recombination reaction $CH_3 + CH_3$ yields $C_2H_6$: Theory, 12:37387 (R;US)
**Reflectivity**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)

**METHYL VIOLOGEN**
*See BIPYRIDINES*

**METHYLBENZENE**
*See TOLUENE*

**2-METHYLBUTANE**
**Thermodynamic Properties**
Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report, 12:36725 (R;US)

**3-METHYLCHOLANTHRENE**
**Carcinogenesis**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
**Toxicity**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)

**METHYLENE CHLORIDE**
**Indoor Air Pollution**
Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)

**METHYL-FUEL**
*See ALCOHOLS*
*METHANOL*

**2-METHYLPROPANE**
**Temperature Effects**
Transport properties of isobutane, 12:37416 (J;US)
**Thermal Conductivity**
Transport properties of isobutane, 12:37416 (J;US)
**Thermodynamic Properties**
Thermodynamic properties of a geothermal working fluid; 90% isobutane-10% isopentane: Final report, 12:36725 (R;US)
**Viscosity**
Transport properties of isobutane, 12:37416 (J;US)

**METROPOLITAN AREAS**
*See URBAN AREAS*

**MEXICO**
**Nuclear Power**
Status of the Mexican nuclear power program, 12:36886 (RA;US)

**MHD GENERATORS**
**Data Base Management**
A centralized MHD data base, 12:37006 (BA;US)

**MICE**
**Immune Reactions**
Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)
**Radioprotective Substances**
Identification of Schistosoma mansoni glycoproteins recognized by protective antibodies from mice immunized with irradiated cercariae, 12:37900 (R;US)

**MICELLAR-POLYMER FLOODING**
*See MICROEMULSION FLOODING*

**MICHIGAN**
**Natural Gas Fields**
Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)
**Oil Fields**
Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)

**MICROBIAL PROCESSES**
*See ANAEROBIC DIGESTION*
*FERMENTATION*

**MICRODOSIMETRY**
Microdosimetric basis for exposure limits, 12:37932 (R;US)

**MICROEMULSION FLOODING**
**Bench-Scale Experiments**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**Research Programs**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**Simulators**
Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**MICROEMULSIONS**
**Diffusion**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986 (Sodium dodecylbenzene sulfonate, sodium chloride, water, n-decane and n-butane), 12:36378 (R;US)
**Stability**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986 (Sodium dodecylbenzene sulfonate, sodium chloride, water, n-decane and n-butane), 12:36378 (R;US)

**MICROSTRUCTURE**
**Correlations**
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)

**MICROWAVE EQUIPMENT**
**Testing**
Tests of a high-power folded waveguide coupler for ICRF heating, 12:38371 (R;US)

**MIGMA DEVICES**
**Stability**
Low beta rigid mode stability criterion for an arbitrary Larmor radius plasma, 12:38334 (R;US)

**MIGRATION (RADIONUCLIDE)**
*See RADIONUCLIDE MIGRATION*

**MILITARY EQUIPMENT**
**Vulnerability**
Safeguarding our military space systems, 12:37190 (J;US)

**MILITARY FACILITIES**
**Alarm Systems**
Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
**Hazardous Materials**
Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)

**MILITARY PERSONNEL**
**Radiation Doses**
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)

**MILK**
**Spray Drying**
The use of recovered heat for preheating air to spray driers, 12:37147 (R;NZ)

**MILK SUGAR**
*See LACTOSE*

**MILKY WAY**
**Gamma Radiation**
Gamma-ray constraint on the nature of dark matter, 12:38077 (J;US)
**Nonluminous Matter**
Gamma-ray constraint on the nature of dark matter, 12:38077 (J;US)

**MILL TAILINGS**
**Environmental Effects**
Environmental Assessment of Remedial Action at the Riverton Uranium Mill Tailings Site, Riverton, Wyoming, 12:36547 (R;US)
Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado: Volume 1, Text, 12:36548 (R;US)
**Radiometric Surveys**
A method to automate the radiological survey process, 12:37819 (R;US)
**Removal**
Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico, 12:36552 (R;US)
**Stabilization**
Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico, 12:36552 (R;US)
**MILLING**
**Environmental Impacts**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**MINE-MOUTH GENERATING PLANTS**
*See COAL MINES*
*FOSSIL-FUEL POWER PLANTS*
**MINERAL OIL**
*See LUBRICANTS*
**MINERAL OILS**
*See also SHALE OIL*
**Biodegradation**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**Extraction**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**MINERAL WASTES**
**Tailings**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**MINERALS**
*See also GARNETS*
*PHOSPHATE MINERALS*
*ZEOLITES*
**Sorptive Properties**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**MINES**
*See also COAL MINES*
**Heat Recovery Equipment**
Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)
**Water Influx**
Energy extraction via downhole heat exchangers in flooded abandoned mines: Applications for district heating and cooling, 12:37159 (BA;US)
**MINING**
*See also COAL MINING*
*HYDRAULIC MINING*
*OIL SHALE MINING*
*SURFACE MINING*
*UNDERGROUND MINING*
**Environmental Impacts**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**MINING EQUIPMENT**
**Cutting Tools**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**MINNESOTA**
**Energy Conservation**
State of Minnesota high level weatherization project, 12:37057 (RA;US)
**MINORITY GROUPS**
Minority participation in new energy technologies: A case example of electric heat pumps, 12:37024 (R;US)
**MISGURNUS**
*See FISHES*
**MISSILE LAUNCHING SITES**
**Vulnerability**
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**MISSILES**
**Vulnerability**
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**MISSISSIPPI**
**Salt Caverns**
Regional ground-water flow near Richton and Cypress Creek Domes, Mississippi: Annual status report for fiscal year 1984, 12:37854 (R;US)
**MITR REACTOR**
**Reactor Operation**
Nuclear reactor and materials science research: Final technical report, May 1, 1985-September 30, 1986 (Academic and research utilization of reactor), 12:36819 (R;US)
**Research Programs**
Nuclear reactor and materials science research: Final technical report, May 1, 1985-September 30, 1986 (Academic and research utilization of reactor), 12:36819 (R;US)
**MIXED OXIDE FUELS**
*Uranium dioxide mixed with other oxides.*
**IAEA Safeguards**
Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
**MIXED-FUNCTION OXIDASE SYSTEMS**
*See MIXED-FUNCTION OXIDASES*
**MIXED-FUNCTION OXIDASES**
**Chemical Composition**
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)
**Enzyme Activity**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
**Fractionation**
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)
**Tissue Distribution**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
**MIXERS**
**Design**
Design of agitation systems in Bingham slurries by pilot simulation, 12:36511 (R;US)
**MIXER-SETTLERS**
**Performance**
Comparison of laboratory and plant mixer-settlers, 12:36487 (R;US)
**MIXTURES**
*See also BINARY MIXTURES*
**Chemical Reaction Kinetics**
Modeling of shock-induced solid state chemistry (Al-Ni, Al-Ti, and ZnO-$Fe_2O_3$), 12:38300 (R;US)
**MOBILE HOMES**
**Energy Efficiency**
Options for reducing energy use in manufactured housing, 12:37032 (RA;US)
**MODELS (ATOMIC)**
*See ATOMIC MODELS*
**MODELS (COSMOLOGICAL)**
*See COSMOLOGICAL MODELS*
**MODELS (FLOW)**
*See FLOW MODELS*
**MODELS (MATHEMATICAL)**
*See MATHEMATICAL MODELS*
**MODELS (NUCLEAR)**
*See NUCLEAR MODELS*
**MODELS (PLASMA)**
*See PLASMA SIMULATION*

**MODELS (STRUCTURAL)**
*See STRUCTURAL MODELS*
**MOISTURE**
**Measuring Instruments**
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
**MOLECULAR BEAMS**
**Beam Production**
The evaporative vector: Homogeneous systems, 12:38094 (R;US)
**Phase Transformations**
The evaporative vector: Homogeneous systems, 12:38094 (R;US)
**MOLECULAR FLUORESCENCE SPECTROSCOPY**
*See FLUORESCENCE SPECTROSCOPY*
**MOLECULAR IONS**
*Coordinate the above descriptor with a descriptor for the specific ion.*
*See also HYDROGEN IONS 2 PLUS*
*HYDROGEN IONS 3 PLUS*
**Infrared Spectra**
The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory ($HCNH^+$, $NNOH^+$, $C_2H_3^+$, $C_2H_2^+$, HSOH, $CH_2^-$), 12:37402 (R;US)
**Molecular Structure**
The development and application of energy derivative methods for various types of configuration interaction wave functions in ab initio electronic structure theory ($HCNH^+$, $NNOH^+$, $C_2H_3^+$, $C_2H_2^+$, HSOH, $CH_2^-$), 12:37402 (R;US)
**MOLECULAR ORBITAL MODEL**
*See ATOMIC MODELS*
*MOLECULES*
**MOLECULES**
**Nuclear Magnetic Resonance**
Two dimensional NMR of liquids and oriented molecules, 12:37401 (R;US)
**Quantum Mechanics**
Quantum chemical methods for massively parallel computers, 12:38308 (R;US)
**Vibrational States**
Picosecond studies of multiphoton absorption: Final technical report, 12:37395 (R;US)
**MOLTEN CARBONATE FUEL CELLS**
*Prior to June 1980 this information was indexed with the descriptors HIGH-TEMPERATURE FUEL CELLS + MOLTEN SALTS + CARBONATES.*
**Commercialization**
Status of commercial fuel cell powerplant system development, 12:37012 (R;US)
**MOLTEN SALT COOLANTS**
*See MOLTEN SALTS*
**MOLTEN SALT REACTORS**
**Reactor Control Systems**
The ultimate safe (U.S.) reactor, 12:36934 (BA;US)
**Reactor Safety**
The ultimate safe (U.S.) reactor, 12:36934 (BA;US)
**Reliability**
The ultimate safe (U.S.) reactor, 12:36934 (BA;US)
**MOLTEN SALTS**
**Absorption Heat**
Systems analysis of the direct-absorption receiver, 12:36670 (BA;US)
**Corrosive Effects**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
**Thermodynamic Properties**
Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
Experiments and analysis on the molten salt direct absorption receiver concept, 12:36667 (BA;US)
**MOLYBDENUM**
**Catalytic Effects**
Rate and selectivity modification in Fischer-Tropsch synthesis over charcoal supported molybdenum by forced concentration cycling, 12:36595 (B;US)
**MOLYBDENUM 100 TARGET**
**Nickel 64 Reactions**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**MOLYBDENUM 98 TARGET**
**Lithium 6 Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}Cu$, 12:38244 (R;US)
**MOLYBDENUM ALLOYS**
*See also ALLOY-IN-100*
*STAINLESS STEEL-316*
**Energy Gap**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
**Superconductivity**
Electron-tunneling studies of Mo/sub 1-x/Re/sub x/: enhancement of superconductivity by a resonance mode, 12:37275 (D;US)
**MOLYBDENUM OXIDES**
**Catalytic Effects**
Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)
**MOMENTUM (LINEAR)**
*See LINEAR MOMENTUM*
**MONGRELS**
*See DOGS*
**MONITORS (AIR POLLUTION)**
*See AIR POLLUTION MONITORS*
**MONITORS (BEAM)**
*See BEAM MONITORS*
**MONITORS (RADIATION)**
*See RADIATION MONITORS*
**MONITORS (REACTOR)**
*See REACTOR CONTROL SYSTEMS*
**MONOCARBOXYLIC ACIDS**
*See also FORMIC ACID*
**Blood-Plasma Clearance**
Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)
**Chemical Preparation**
Nuclear medicine progress report for quarter ending December 31, 1986, 12:37878 (R;US)
**MOROCCO**
**Fuel Substitution**
Development possibilities of solid mineral fuels in the energy balance of Morocco, 12:36978 (R;FR;In French)
**MORTALITY**
Prediction of the mortality dose-response relationship in man, 12:37901 (R;US)
**MORTARS**
**Waste Product Utilization**
Fly ash quality as a function of burned coal and layout of firing equipment, and suitability of different fly ash qualities for use in industry. Final report, 12:36325 (R;DE;In German)
**MOTORBOATS**
**Fuel Consumption**
Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats, 12:36955 (R;US)
**MOUNTAINS**
*See also YUCCA MOUNTAIN*
**Air Pollution**
Dispersion in complex terrain: a summary of the AMS (American Meteorological Society) workshop held in Keystone, Colorado, 17-20 May 1983 (journal version), 12:37663 (R;US)
**MT ST HELENS**
**Volcanoes**
Mount St. Helens: the aftermath, 12:37673 (R;US)
**MUCOSA**
*See MUCOUS MEMBRANES*
**MUCOUS MEMBRANES**
**Inflammation**
Biochemical and cellular changes in nasal lavages after intranasal instillation of endotoxin, 12:37983 (RA;US)

**MULLITE**
Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
**MULTIPHASE FLOW**
**Flow Models**
Advanced research in instrumentation and control technology: multiphase flow studies, 12:36244 (RA;US)
**Modifications**
Reduction of erosion in elbows due to flow field modifications, 12:36347 (RA;US)
**Test Facilities**
Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period March 1, 1987 to May 31, 1987, 12:37493 (R;US)
**MULTIPROCESSING**
*See PARALLEL PROCESSING*
**MULTIPROCESSORS**
*See ARRAY PROCESSORS*
**MULTIWIRE DRIFT CHAMBERS**
*See DRIFT CHAMBERS*
**MUNICIPAL BUILDINGS**
*See PUBLIC BUILDINGS*
**MUNICIPAL WASTES**
**Gasification**
Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
**Pyrolysis**
Pyrolysis of municipal solid waste, 12:37154 (R;US)
**Sewage Sludge**
Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo, 12:37842 (R;US)
**Sludges**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**MUON NEUTRINOS**
**Neutrino Oscillation**
Comparison of narrow-band and wide-band neutrino beams in the search for $\nu$/sub $\mu$/$\rightarrow\nu$/sub e/ oscillations, 12:38150 (J;US)
**MUON-CATALYZED FUSION**
**Fusion Yield**
Enhancing the muon-catalyzed fusion yield, 12:38324 (R;US)
**Heavy Ion Fusion Reactions**
Enhancing the muon-catalyzed fusion yield, 12:38324 (R;US)
**MUONS**
*See also COSMIC MUONS*
**Pair Production**
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Results from PETRA, 12:38135 (RA;US)
**Particle Production**
Results from PETRA, 12:38135 (RA;US)
**MUSEUMS**
*See EDUCATIONAL FACILITIES*
**MUTAGENS**
**Bioassay**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**Risk Assessment**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)
**MYLAR**
**Ion Microprobe Analysis**
Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)
**Mass Spectroscopy**
Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)

## N

**NAPAP**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Inventories**
National Acid Precipitation Assessment Program (NAPAP) Utility Reference File, 1980: Electric Utility Data Base. Data file, 12:36763 (R;US)
National Acid Precipitation Assessment Program (NAPAP) Utility reference file, 1980. Final report, January 1985-October 1986, 12:36764 (R;US)
**NAPHTHALENE**
**Ecological Concentration**
Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University, 12:37619 (RA;US)
**NAPHTHENES**
*See CYCLOALKANES*
**NASA-TEST REACTOR**
*See PBR REACTOR*
**NASA-TR REACTOR**
*See PBR REACTOR*
**NATIONAL ACID PRECIPITATION ASSESSMENT PR**
*See NAPAP*
**NATIONAL DEFENSE**
*See also BALLISTIC MISSILE DEFENSE*
Quarterly status of Department of Energy Projects, 12:36971 (R;US)
**NATIONAL ENVIRONMENTAL POLICY ACT**
**Implementation**
Environmental Assessment Technical Assistance Handbook, 12:36964 (R;US)
**NATIONAL REACTOR TESTING STATION**
*See IDAHO NATIONAL ENGINEERING LABORATORY*
**NATURAL CIRCULATION**
*See NATURAL CONVECTION*
**NATURAL CONVECTION**
**Flow Models**
Flow coefficients for interzonal natural convection for various apertures, 12:36691 (BA;US)
**NATURAL GAS**
**Chemical Composition**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985 (From different sources: sedimentary, abiogenic and subducted zones), 12:36430 (R;US)
**Combustion**
Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)
**Combustion Heat**
Simplified method for determining heat of combustion of natural gas, 12:36462 (R;US)
**Combustion Kinetics**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)
**Contracts**
Economic analysis of natural gas contracts, 12:36435 (R;NO)
**Economic Analysis**
Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation, 12:36954 (R;US)
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Flow Rate**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
Economic analysis of natural gas contracts, 12:36435 (R;NO)
**Reserves**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)

**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Taxes**
Petroleum taxes and optimal resource recovery, 12:36414 (R;NO)
**Transport**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)

**NATURAL GAS APPLIANCES**
*See GAS APPLIANCES*

**NATURAL GAS DEPOSITS**
*See also GAS CONDENSATE FIELDS*
*NATURAL GAS FIELDS*
**Enhanced Recovery**
Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)
**Exploration**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Geochemistry**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Geophysics**
Reliability of laboratory measurement of porosity in tight gas sands, 12:36432 (BA;US)
The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
**Geopressure Anomalies**
Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)
**Mathematical Models**
Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)
**Resource Assessment**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Resource Development**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)

**NATURAL GAS DISTRIBUTION SYSTEMS**
**Land Reclamation**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Land Use**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Pipelines**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Water Reclamation**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)

**NATURAL GAS FIELDS**
**Feasibility Studies**
An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado, 12:36442 (BA;US)

**NATURAL GAS GATHERING SYSTEMS**
*See NATURAL GAS DISTRIBUTION SYSTEMS*

**NATURAL GAS INDUSTRY**
**Offshore Operations**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
**Pipelines**
Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
**Production**
International Energy Statistical Review. Monthly report, 12:36986 (R;US)

**NATURAL GAS LIQUIDS**
*See also LIQUEFIED PETROLEUM GASES*
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)

**NATURAL GAS WELLS**
**Carbon Dioxide Injection**
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)
**Directional Drilling**
Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)
Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)
Performance comparison of vertical and horizontal hydraulic fractures and horizontal boreholes in low permeability reservoirs: A numerical study, 12:36453 (BA;US)
Recovery efficiency aspects of horizontal well drilling in Devonian shale, 12:36434 (BA;US)
Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)
**Feasibility Studies**
Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
**Flow Models**
An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)
**Flow Rate**
Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)
**Formation Damage**
An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)
Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)
**Hydraulic Fracturing**
Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)
An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)
An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado, 12:36442 (BA;US)
An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)
Case history of hydraulic fracture performance in the naturally fractured Paludal zone: The transitory effects of damage, 12:36457 (BA;US)
Coupling of production forecasting, fracture geometry requirements and treatment scheduling in the optimum hydraulic fracture design, 12:36391 (BA;US)
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)
Dynamic etching tests aid fracture acidizing treatment design, 12:36390 (BA;US)
Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment, 12:36393 (BA;US)
Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)
In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)

Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)
Mechanical interactions in branched or subparallel hydraulic fractures, 12:36398 (BA;US)
Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)
New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)
Observations and recommendations in the evaluation of tests of hydraulically fractured wells, 12:36405 (BA;US)
On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)
Performance comparison of vertical and horizontal hydraulic fractures and horizontal boreholes in low permeability reservoirs: A numerical study, 12:36453 (BA;US)
Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)
Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs, 12:36388 (B;US)
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
Successful field application of high-temperature rheology of CO/sub 2/ foam fracturing fluids, 12:36448 (BA;US)
The analysis of complex Travis Peak reservoirs in east Texas, 12:36441 (BA;US)
The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)
The GRI staged field experiment, 12:36440 (BA;US)
The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)
The influence of reservoir properties and geologic setting on coalbed fracturing and production: A preliminary evaluation of the TEAM project, 12:36444 (BA;US)
Transient pressure behavior of multiple-fractured gas wells, 12:36456 (BA;US)

**Mathematical Models**
An assessment of tight sand development potential in the south Rulison area, Garfield County, Colorado, 12:36442 (BA;US)

**Meetings**
Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs, 12:36388 (B;US)

**Performance**
Performance comparison of vertical and horizontal hydraulic fractures and horizontal boreholes in low permeability reservoirs: A numerical study, 12:36453 (BA;US)

**Pressure Gradients**
Transient pressure behavior of multiple-fractured gas wells, 12:36456 (BA;US)

**Production**
An analysis of the coal and coalbed methane resources of the Piceance Basin, Colorado, 12:36447 (BA;US)
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)
Recovery efficiency aspects of horizontal well drilling in Devonian shale, 12:36434 (BA;US)
Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs, 12:36446 (BA;US)
The influence of reservoir properties and geologic setting on coalbed fracturing and production: A preliminary evaluation of the TEAM project, 12:36444 (BA;US)
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)

**Productivity**
Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)

**Propping Agents**
Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)
Long-term performance of proppants under simulated reservoir conditions, 12:36400 (BA;US)
On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)

**Reservoir Pressure**
The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)

**Resource Depletion**
Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)

**Site Selection**
Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)

**Sonic Logging**
Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)

**Testing**
Observations and recommendations in the evaluation of tests of hydraulically fractured wells, 12:36405 (BA;US)

**Well Logging**
In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)

**Well Stimulation**
The use of simulation and history matching to determine critical coalbed methane reservoir properties, 12:36445 (BA;US)

**NATURAL GASOLINE**
*See NATURAL GAS LIQUIDS*

**NATURAL LIGHTING**
*See DAYLIGHTING*

**NATURAL URANIUM**

**Geochemistry**
Uranium in selected endorheic basins as partial analogue for spent fuel behavior in salt, 12:36478 (R;US)

**NATURE RESERVES**

**Management**
Resource Management Plan for the Oak Ridge Reservation: Volume 23, Oak Ridge National Environmental Research Park, Research Sites, and State Natural Areas, 12:36963 (R;US)

**NAVIER-STOKES EQUATION**
*See NAVIER-STOKES EQUATIONS*

**NAVIER-STOKES EQUATIONS**

**Numerical Solution**
Alignment of vorticity and scalar gradient with strain rate in simulated Navier—Stokes turbulence, 12:38106 (J;US)

**NEODYMIUM ALLOYS**

**Magnetic Properties**
Aluminum substitutions in Nd-Fe-B sintered magnets, 12:37224 (R;US)
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**Microstructure**
Effect of Dy additions on microstructure and magnetic properties of Fe-Nd-B magnets, 12:37225 (R;US)

**NEON 20 TARGET**

**Neutrino Reactions**
Limits on likesign dilepton production in $\nu$/sub $\mu$/ interactions, 12:38243 (BA;US)

**NEOPLASMS**
*See also CARCINOMAS*
*SARCOMAS*

**Radioinduction**
Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. II, 12:37925 (RA;US)
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
Late-occurring nonstochastic effects from internal-emitting radionuclides - results from studies in animals, 12:37923 (RA;US)

Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
The multicellular nature of radiation carcinogenesis, 12:37934 (BA;US)
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII, 12:37912 (RA;US)
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 μ AMAD particles. B. Monodisperse 3.0 μm particles. XIII, 12:37918 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX, 12:37919 (RA;US)
**Risk Assessment**
Comparative potency of complex mixtures: use of short-term genetic bioassays in cancer risk assessment, 12:38003 (R;US)

**NEPA**
*See NATIONAL ENVIRONMENTAL POLICY ACT*

**NETWORKS (COMPUTER)**
*See COMPUTER NETWORKS*

**NEUTRAL-PARTICLE TRANSPORT**
**Vector Processing**
Vectorizing and macrotasking Monte Carlo neutral particle algorithms, 12:38352 (R;US)

**NEUTRETTOS**
*See MUON NEUTRINOS*

**NEUTRINO OSCILLATION**
Resonant neutrino oscillations, 12:38193 (RA;US)
**Reviews**
Review of the Brookhaven neutrino workshop, 12:38113 (R;US)

**NEUTRINO REACTIONS**
**Capture**
Limits on likesign dilepton production in ν/sub μ/ interactions, 12:38243 (BA;US)
**Particle Production**
Limits on likesign dilepton production in ν/sub μ/ interactions, 12:38243 (BA;US)

**NEUTRINO-ELECTRON INTERACTIONS**
**Elastic Scattering**
ν/sub μ/e → ν/sub μ/e and ν/sub μ/p → ν/sub μ/p, 12:38114 (R;US)
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)
**Scattering**
Results on theta/sub w/ from the CERN high-energy neutrino experiments or: why theta/sub w/? How theta/sub w/?, 12:38133 (RA;US)

**NEUTRINO-NUCLEON INTERACTIONS**
*See also NEUTRINO-PROTON INTERACTIONS*
**Scattering**
Results on theta/sub w/ from the CERN high-energy neutrino experiments or: why theta/sub w/? How theta/sub w/?, 12:38133 (RA;US)

**NEUTRINO-PROTON INTERACTIONS**
**Elastic Scattering**
ν/sub μ/e → ν/sub μ/e and ν/sub μ/p → ν/sub μ/p, 12:38114 (R;US)
Elastic scattering of muon neutrinos at BNL, 12:38115 (R;US)

**NEUTRINOS**
*See also ANTINEUTRINOS*
*COSMIC NEUTRINOS*
*ELECTRON NEUTRINOS*
*MUON NEUTRINOS*
*SOLAR NEUTRINOS*
**Mass**
Status of double beta decay of Ge, 12:38250 (BA;US)
**Particle Identification**
Counting neutrinos at SLC, 12:38189 (RA;US)
**Particle Production**
Bound on the number of neutrinos from $e^+e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA, 12:38128 (RA;US)
Counting neutrinos at SLC, 12:38189 (RA;US)
Physics from PEP, 12:38134 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)

**NEUTRON ACTIVATION ANALYSIS**
*See NEUTRON REACTIONS*

**NEUTRON CAPTURE**
*See NEUTRON REACTIONS*

**NEUTRON DOSIMETRY**
**Gas Scintillation Detectors**
Evaluation of a digital optical ionizing radiation particle track detector, 12:37568 (R;US)
**Neutron Spectroscopy**
Radiation dosimetry through spectral definition, 12:37572 (J;NL)

**NEUTRON ECONOMY**
*See NEUTRON FLUX*

**NEUTRON EMISSION**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Probability**
1986 evaluation of delayed-neutron emission probabilities, 12:38245 (R;US)

**NEUTRON EVAPORATION**
*See NEUTRON EMISSION*

**NEUTRON FLUX**
**Energy Spectra**
Neutron spectrum adjustment with SANDII using arbitrary trial functions, 12:36800 (R;US)

**NEUTRON FLUX DENSITY**
*See NEUTRON FLUX*

**NEUTRON MATTER**
*See NUCLEAR MATTER*

**NEUTRON MONITORS**
**Design**
A neutron portal monitor for vehicles, 12:36562 (R;US)

**NEUTRON REACTIONS**
**Capture**
Neutron capture cross sections for $^{86}Sr$ and $^{87}Sr$ at stellar temperatures, 12:38247 (BA;DE)
Neutron capture resonances of /sup 152/Gd and /sup 154/Gd, 12:38278 (J;US)
**Fission**
Coriolis interaction and variable reflection asymmetry in fission vibrational resonances, 12:38277 (J;US)
**Inelastic Scattering**
Microscopic distorted-wave approximation study of low-energy nucleon scattering from /sup 89/Y, 12:38246 (J;US)
**Integral Cross Sections**
Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range, 12:38233 (R;US)
**T Invariance**
Proposal for a high sensitivity search for T-violation in slow neutron resonances, 12:38284 (BA;DE)

**NEUTRON SOURCES**
*Excludes reactors even when used as neutron sources.*
**Comparative Evaluations**
Use of generator produced neutrons in coal analysis: Quarterly report, September 16, 1986-December 15, 1986, 12:36312 (R;US)
**Design**
Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range, 12:38233 (R;US)
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986, 12:36313 (R;US)
**Performance Testing**
Development of the Be(d,n) neutron source for cross-section investigations in the few-MeV energy range, 12:38233 (R;US)
**Pulse Techniques**
Use of generator produced neutrons in coal analysis: Quarterly report, December 16, 1985-March 15, 1986, 12:36313 (R;US)

**NEUTRON STARS**
**Measuring Methods**
Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986, 12:38050 (R;US)
**NEUTRON-NEUTRON INTERACTIONS**
**Partial Waves**
Charge asymmetry of the nuclear interaction and neutron-neutron scattering parameters, 12:38201 (J;US)
**NEUTRONS**
*See also SOLAR NEUTRONS*
**Charge Distribution**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Electromagnetic Form Factors**
Polarization in electron scattering experiments at CEBAF [Continuous Electron Beam Accelerator Facility], 12:38235 (R;US)
**Mass**
Can the neutrino mass be measured using /sup 163/Ho electron capture, 12:38259 (BA;US)
**Mirrors**
Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report], 12:38292 (R;US)
**NEUTROPHILS**
**Biological Functions**
Acute effects of neutrophils on nasal epithelial mucosubstances: quantitative histochemistry, 12:37984 (RA;US)
Biochemical and cellular changes in nasal lavages after intranasal instillation of endotoxin, 12:37983 (RA;US)
**NEVADA**
**Ground Water**
Groundwater chemistry at Yucca Mountain, Nevada, and vicinity (NNWSI), 12:36519 (R;US)
**NEVADA TEST SITE**
**Ground Water**
Carbon and isotopic mass balance models of Oasis Valley-Fortymile Canyon ground water basin, southern Nevada, 12:37823 (J;US)
**NEW ENGLAND**
*See FEDERAL REGION I*
**NEW MEXICO**
**Remedial Action**
Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico, 12:36552 (R;US)
**NEW YORK**
**Radioactive Waste Facilities**
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
**NEW ZEALAND**
**Electric Power**
Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation, 12:36954 (R;US)
**Natural Gas**
Analysis of market shares for gas and electricity: indicative costs and benefits of gas reticulation, 12:36954 (R;US)
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Wind Power**
Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report, 12:36735 (R;NZ)
**NEWTON MECHANICS**
*See CLASSICAL MECHANICS*
**NGL**
*See NATURAL GAS LIQUIDS*
**NICKEL**
**Acoustic Emission Testing**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**Catalytic Effects**
Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Creep**
The migration and coalescence of tritium-induced helium bubbles during creep in nickel, 12:38388 (J;US)
**Grain Size**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**Helium Embrittlement**
The migration and coalescence of tritium-induced helium bubbles during creep in nickel, 12:38388 (J;US)
**Magnetic Testing**
On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)
**Radiation Effects**
Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)
**Toxicity**
Changes in collagen and DNA from nickel subsulfide-injured pulmonary alveolar macrophages cultured with lung fibroblasts, 12:37971 (RA;US)
**NICKEL 58 TARGET**
**Neutron Reactions**
Calculated neutron-induced cross sections for /sup 58,60/Ni from 1 to 20 MeV and comparisons with experiments, 12:38274 (R;US)
**NICKEL 59**
**Radiation Effects**
Design of a single variable helium effects experiment for irradiation in FFTF [Fast Flux Test Facility] using alloys enriched in nickel 59, 12:37220 (R;US)
**NICKEL 60 TARGET**
**Neutron Reactions**
Calculated neutron-induced cross sections for /sup 58,60/Ni from 1 to 20 MeV and comparisons with experiments, 12:38274 (R;US)
**NICKEL 64 REACTIONS**
**Heavy Ion Fusion Reactions**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**NICKEL 64 TARGET**
**Oxygen 18 Reactions**
Microscopic analysis of projectile excitation for /sup 18/O+/sup 64/Ni, 12:38276 (J;US)
**NICKEL BASE ALLOYS**
*See also ALLOY-IN-100*
**Annealing**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Corrosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Corrosion Resistance**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
**Erosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Mechanical Properties**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
**Microhardness**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Reactor Materials**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
**Stress Relaxation**
Effect of tensile stress on the annealed structure of a metallic glass, 12:37253 (J;US)
**Wear Resistance**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)

**Weldability**
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)

**NICKEL COMPLEXES**
**Catalytic Effects**
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)

**NICKEL COMPOUNDS**
*See also NICKEL OXIDES*
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)

**NICKEL OXIDES**
**Catalytic Effects**
Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)

**NICKEL-CADMIUM BATTERIES**
**Battery Chargers**
Aircraft battery state of charge and charge-control system. Interim report, 1 July 1985-30 June 1986, 12:36940 (R;US)

**NICKEL-CHROMIUM STEELS**
**Mechanical Properties**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)

**NIOBIUM**
**Cladding**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)
**Oxidation**
Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Annual technical report, November 1985-January 1986, 12:37198 (R;US)

**NIOBIUM ALLOYS**
*See also INCONEL 600*
**Corrosion Resistance**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)
**Oxidation**
Effect of alloying, rapid solidification, and surface kinetics on the high-temperature environmental resistance of niobium. Annual technical report, November 1985-January 1986, 12:37198 (R;US)
**Superconducting Junctions**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
**Superconductivity**
Importance of spacing in the development of high current densities in multifilamentary superconductors, 12:37255 (J;GB)
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)

**NIOBIUM CARBIDES**
**Creep**
Kinetics and mechanisms of creep in hot isostatically pressed niobium carbide, 12:37281 (R;US)

**NIOBIUM NITRIDES**
**Superconducting Junctions**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
**Superconductivity**
Microstructure, resistivity and the anisotropy of the upper critical field in NbN thin films, 12:37283 (R;US)

**NITRATES**
*See also EUROPIUM NITRATES*
*LANTHANUM NITRATES*
**Absorption Heat**
The feasibility and potential of a direct absorption receiver in a nitrate salt solar power system, 12:36668 (BA;US)
**Adsorption**
Comparison of indoor dust samples collected in different environments, 12:37618 (RA;US)

**NITRIC ACID**
**Air Pollution**
Nitric acid-air diffusion coefficient: experimental determination, 12:37639 (R;US)
**Air Pollution Monitoring**
Transition-flow reactor tube for measuring trace-gas concentrations, 12:37646 (R;US)
**Atmospheric Chemistry**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)

**NITRIC OXIDE**
*NO.*
**Chemical Reactions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)

**NITROCELLULOSE**
**Aging**
Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring, 12:37585 (R;US)
**NMR Spectra**
Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring, 12:37585 (R;US)
**Quantitative Chemical Analysis**
An attempt to use high resolution FTIR spectra to determine the population of the various nitrate esters in cellulose nitrate, 12:37381 (R;US)
**Stability**
Evidence for differences in stability between nitrate ester positions on the cellulose nitrate ring, 12:37585 (R;US)

**NITROGEN**
**Atmospheric Chemistry**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**Biological Effects**
Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Excitation**
Studies of infrared aurorae. Technical report, 12:38041 (R;US)
**Ion Collisions**
State-selected study of ion-molecule reactions using tandem molecular beam photoionization mass spectrometry. II. Absolute spin-orbit-state excitation cross sections for the reactions $Ar^+(^2P/sub\ 3/2/) + Ar(^1S_0)$ and $Ar^+(^2P/sub\ 3/2/) + N_2(X,v = 0)$, 12:38097 (D;US)
**Raman Spectroscopy**
Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)
**Uptake**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)

**NITROGEN 14 REACTIONS**
**Fragmentation**
Intermediate-mass fragments from nonbinary processes in the reaction of /sup 14/N on Ag at E/A = 35 MeV, 12:38254 (J;US)

**NITROGEN DIOXIDE**
$NO_2$.
**Biological Effects**
Work performance evaluation using the exercising rat model, 12:37959 (R;US)
**Deposition**
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)

**Environmental Transport**
Two-zone modelling for air exchange rates and $NO_2$ source and decay rates in a Southern California residential indoor air quality study, 12:37600 (R;US)
**Indoor Air Pollution**
Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)
**Pollution Sources**
Two-zone modelling for air exchange rates and $NO_2$ source and decay rates in a Southern California residential indoor air quality study, 12:37600 (R;US)
**Removal**
Investigation of nitrogen dioxide removal from indoor air. Final report, December 1984-September 1986, 12:37686 (R;US)

**NITROGEN FIXATION**
**Gene Regulation**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**Molecular Biology**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)

**NITROGEN NITRIDES**
*See NITROGEN*

**NITROGEN OXIDES**
*See also NITRIC OXIDE*
*NITROGEN DIOXIDE*
*NITROUS OXIDE*
**Air Pollution Control**
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
**Atmospheric Chemistry**
Studies of the mechanisms and rates with which nitrogen species are incorporated into cloud water and precipitation (second annual report), 12:37658 (R;US)
**Control**
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
Multistaged approach for in-furnace NOx control. Report for August 1986-February 1987, 12:37522 (R;US)
Reburning application to firetube package boilers. Final report, May 1983-September 1985, 12:37649 (R;US)
**Infrared Spectra**
Studies of infrared aurorae. Technical report, 12:38041 (R;US)
**Photochemical Reactions**
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
**Removal**
Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)

**NITROSO COMPOUNDS**
**Carcinogenesis**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)
**Toxicity**
Interaction of radiation and carcinogens in the production of mutations, 12:37928 (RA;US)

**NITROUS OXIDE**
*$N_2O$.*
**Indoor Air Pollution**
Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)
**Infrared Spectra**
Medium- and long-wave infrared absorption spectra of carbon dioxide and nitrous oxide at 800k, 12:38018 (R;US)

**NMR**
*See NUCLEAR MAGNETIC RESONANCE*

**NMR SPECTRA**
**D Codes**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**I Codes**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**P Codes**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**Q Codes**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**R Codes**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)

**NOISE POLLUTION**
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)
**Biological Effects**
Study investigating the impact of aircraft noise on physiological, endocrinological and ethological criteria with regard to pregnant sows, roaming free or kept in barns, 12:38014 (R;DE;In German)

**NONDESTRUCTIVE ANALYSIS**
*See also RADIATION ABSORPTION ANALYSIS*
**Calibration Standards**
A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)

**NONDESTRUCTIVE TESTING**
**Nuclear Magnetic Resonance**
Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)

**NONLUMINOUS MATTER**
*(In outer space.)*
**Detection**
Ultralow background searches for $\beta\beta$-decay, cold dark matter and solar axions, 12:38248 (BA;DE)

**NONRADIOACTIVE WASTE DISPOSAL**
*See WASTE DISPOSAL*

**NONRADIOACTIVE WASTES**
*See GASEOUS WASTES*
*SOLID WASTES*
*WASTES*

**NORTH ATLANTIC REGION**
*See FEDERAL REGION I*

**NORTH SEA**
**Natural Gas Fields**
On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)
**Oil Fields**
On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)

**NORTHERN IRELAND**
*See UNITED KINGDOM*

**NORWAY**
**Acid Rain**
RAIN project. Annual report for 1984, 12:37622 (R;NO)
**Aquatic Ecosystems**
Wild-life studies in the Alta watercourse. Survey report for 1982-1984, 12:37766 (R;NO;In Norwegian)
**Oil Spills**
Long term effects of oil on marine benthic communities in enclosures, 12:36420 (R;NO)
**Pollution Control**
Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)
**Water Pollution**
Long term effects of oil on marine benthic communities in enclosures, 12:36420 (R;NO)

**Wild Animals**
Wild-life studies in the Alta watercourse. Survey report for 1982-1984, 12:37766 (R;NO;In Norwegian)
**NOS. 4, 5, AND 6 FUEL OILS**
*See RESIDUAL FUELS*
**NOS. 5 AND 6 BURNER OILS**
*See RESIDUAL FUELS*
**NPR REACTOR**
*See N-REACTOR*
**N-REACTOR**
**Compiled Data**
UNC environmental surveillance report for the 100 areas: FY 1986, 12:36817 (R;US)
**Environmental Effects**
UNC environmental surveillance report for the 100 areas: FY 1986, 12:36817 (R;US)
UNC environmental surveillance report for the 100 areas: FY 1985, 12:36816 (R;US)
**Site Surveys**
UNC environmental surveillance report for the 100 areas: FY 1986, 12:36817 (R;US)
UNC environmental surveillance report for the 100 areas: FY 1985, 12:36816 (R;US)
**NRTS**
*See IDAHO NATIONAL ENGINEERING LABORATORY*
**NRTS-ETR REACTOR**
*See ETR REACTOR*
**NUCLEAR ACCIDENTS**
*See ACCIDENTS*
**NUCLEAR ATTACKS**
*See NUCLEAR WEAPONS*
**NUCLEAR CONTROVERSY**
*See HUMAN POPULATIONS*
**NUCLEAR DETERRENCE**
Arms control and future limits on nuclear weapons, 12:37193 (J;US)
Avoiding war with the Soviet Union, 12:37192 (J;US)
Road to a more stable peace, 12:37189 (J;US)
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**NUCLEAR ENERGY**
**Economics**
The cost of kWh generated from nuclear stations, 12:36798 (R;IT;In Italian)
**Research Programs**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
**NUCLEAR EXPLOSION DETECTION**
Technical report for the period 1 October-31 December 1986, 12:37597 (R;US)
**NUCLEAR EXPLOSIONS**
*Specifically named single nuclear explosions are listed by name and the word EVENT, e.g., BOXCAR EVENT. All projects involving nuclear explosions are listed by the project name and the word PROJECT, e.g., PLOWSHARE PROJECT.*
*See also CROSSROADS PROJECT*
*GREENHOUSE PROJECT*
**Atmospheric Explosions**
Particle-size determination from local fallout. Master's thesis, 12:37587 (R;US)
System design-requirements tool for satellite communications through nuclear-induced scintillation. Final report, 30 September 1985-10 April 1987 on Phase 1, 12:37580 (R;US)
**Crossroads Project**
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)
**Fallout**
Computer fallout code using variable winds for operational-type studies. Master's thesis, 12:37586 (R;US)
**Greenhouse Project**
Operation Greenhouse. Scientific director's report of atomic weapon tests at eniwetok, 1951. Annex 9.1. Staff reports. Parts 1 to 4. Annex 9.4. Documentary photography, 12:37590 (R;US)
**Neutron Spectra**
Radiation dosimetry through spectral definition, 12:37572 (J;NL)
**NUCLEAR FACILITIES**
*See also FEED MATERIALS PLANTS*
*FUEL REPROCESSING PLANTS*
*NUCLEAR POWER PLANTS*
*RADIOACTIVE WASTE FACILITIES*
**Accidents**
Using operating experience and a cause coding tree to identify improvements for nuclear process control, 12:36825 (R;US)
**Communications**
Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
**Entry Control Systems**
A neutron portal monitor for vehicles, 12:36562 (R;US)
**Inspection**
A safeguards risk approach to inspection scheduling, 12:36557 (R;US)
**Robots**
3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)
**Safeguards**
A safeguards risk approach to inspection scheduling, 12:36557 (R;US)
Verification of a modular Safeguards Control and Communication System, 12:36564 (R;US)
**Safety**
Seismic hazard methodology for nuclear facilities: modeling input interpretations, 12:36892 (RA;US)
**Seismic Effects**
Seismic hazard methodology for nuclear facilities: modeling input interpretations, 12:36892 (RA;US)
**NUCLEAR FUEL ELEMENTS**
*See FUEL ELEMENTS*
**NUCLEAR MAGNETIC RESONANCE**
**Magnetic Fields**
Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)
**NUCLEAR MATERIALS MANAGEMENT**
Statistically stable branch method for improving accountability and control, 12:36573 (R;US)
The R and D/operational MC and A [materials control and accounting] interface (Materials control and accounting), 12:36560 (R;US)
**Accounting**
A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)
**Calculation Methods**
Statistically stable branch method for improving accountability and control, 12:36573 (R;US)
**Radiation Monitoring**
New portable hand-held radiation instruments for measurements and monitoring, 12:36561 (R;US)
**NUCLEAR MATTER**
**Equations of State**
Supernovae and high density nuclear matter, 12:38285 (BA;DE)
**NUCLEAR MODELS**
**Supersymmetry**
Dynamical supersymmetric Diract Hamiltonians, 12:38287 (BA;US)
**Symmetry**
Empirical evidences for fermion dynamical symmetries in nuclei, 12:38288 (BA;US)
**NUCLEAR PHYSICS**
*Use only for indexing articles of very broad coverage, such as annual reviews, text books, etc.*
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
**Research Programs**
Annual report on nuclear physics activities. July 1, 1985-June 30, 1986, 12:38231 (R;DE)
Institute for Nuclear Study, University of Tokyo: Annual report, January-December 1984, 12:38232 (R;US)

Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**NUCLEAR POWER**

**Economics**

The future of nuclear power, 12:36975 (R;US)

**Political Aspects**

The future of nuclear power, 12:36975 (R;US)

**Public Opinion**

The future of nuclear power, 12:36975 (R;US)

**Safety**

The future of nuclear power, 12:36975 (R;US)

**NUCLEAR POWER PLANTS**

New buildup factor data for point kernel calculations, 12:38291 (R;US)

**Computerized Control Systems**

IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0, 12:36814 (R;US)

**Computerized Simulation**

IMAGE information monitoring and applied graphics software environment for the IBM-PC: Volume 2, User's manual for version 2.0, 12:36814 (R;US)

**Control Rooms**

Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)

**Economics**

The cost of kWh generated from nuclear stations, 12:36798 (R;IT;In Italian)

**Emergency Plans**

Onsite assessments of the effectiveness and impacts of upgraded emergency operating procedures, 12:36920 (R;US)

**Engineered Safety Systems**

Seismic-fragility tests of new and accelerated-aged Class 1E battery cells, 12:36918 (R;US)

**Fire Hazards**

Quantitative data on the fire behavior of combustible materials found in nuclear power plants: A literature review, 12:36923 (R;US)

**Fires**

Enclosure environment characterization testing for the base line validation of computer fire simulation codes, 12:36924 (R;US)

**Legal Aspects**

Indexes to Nuclear Regulatory Commission issuances, July-September 1986, 12:36792 (R;US)

**Pipes**

Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986, 12:36804 (R;US)

Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)

**Primary Coolant Circuits**

System for removing contaminated surface layers, 12:36807 (TG;US)

**Reactor Accidents**

Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)

**Reactor Components**

Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)

Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)

The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)

US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Reactor Control Systems**

Signal validation in nuclear power plants: Progress report No. 2, 12:36813 (R;US)

Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)

**Reactor Maintenance**

Plant lifetime reliability and risk: Addressing today's strategies for making tomorrow's decisions, 12:36823 (R;US)

**Reactor Materials**

Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)

**Reactor Operators**

Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)

**Reactor Safety**

Role of oversight within NRR and its effect on industry, 12:36893 (RA;US)

Seismic hazard methodology for nuclear facilities: modeling input interpretations, 12:36892 (RA;US)

Seismic safety research program plan, 12:36834 (R;US)

Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)

US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Reliability**

US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Seismic Effects**

Seismic hazard methodology for nuclear facilities: modeling input interpretations, 12:36892 (RA;US)

Seismic safety research program plan, 12:36834 (R;US)

Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Dislocation models of near-source earthquake ground motion: A review, 12:36928 (R;US)

**Service Life**

Plant lifetime reliability and risk: Addressing today's strategies for making tomorrow's decisions, 12:36823 (R;US)

The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)

US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Signals**

Signal validation in nuclear power plants: Progress report No. 2, 12:36813 (R;US)

**NUCLEAR POWER STATIONS**

*See NUCLEAR POWER PLANTS*

**NUCLEAR REACTIONS**

*See also HADRON REACTIONS*
*HEAVY ION FUSION REACTIONS*
*PHOTONUCLEAR REACTIONS*

**Invariance Principles**

Nuclear probes of fundamental symmetries, 12:38283 (BA;DE)

**Particle Production**

Statistical analysis of secondary particle distributions in relativistic nucleus-nucleus collisions, 12:38273 (R;US)

**Statistical Models**

Statistical analysis of secondary particle distributions in relativistic nucleus-nucleus collisions, 12:38273 (R;US)

**NUCLEAR SAFETY**

*See RADIATION PROTECTION*

**NUCLEAR SPIN RESONANCE**

*See NUCLEAR MAGNETIC RESONANCE*

**NUCLEAR STRUCTURE**

**Reviews**

Nuclear structure problems in double beta decay, 12:38290 (BA;US)

**NUCLEAR WASTES**

*See RADIOACTIVE WASTES*

**NUCLEAR WEAPON TESTS**

*See NUCLEAR EXPLOSIONS*

**NUCLEAR WEAPONS**

**Arms Control**

Arms control activities in LLNL, 12:37195 (J;US)

Arms control and future limits on nuclear weapons, 12:37193 (J;US)

Laboratory and arms control, 12:37188 (J;US)

Road to a more stable peace, 12:37189 (J;US)

Transition to deterrence based on strategic defense, 12:37191 (J;US)

**Ballistic Missile Defense**
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**Military Strategy**
Command and control of the US heavy division on the nuclear battlefield, 12:37588 (R;US)
Tactical encirclement reductions, 12:37589 (R;US)
**Storage Facilities**
Vault demonstration program (Near surface vault storage), 12:37596 (R;US)

**NUCLEI**
*See also EVEN-EVEN NUCLEI*
*HYPERNUCLEI*
**Interacting Boson Model**
Symmetries in heavy nuclei and the proton-neutron interaction, 12:38286 (BA;US)
**Symmetry**
Symmetries in heavy nuclei and the proton-neutron interaction, 12:38286 (BA;US)

**NUCLEON-NUCLEON INTERACTIONS**
*See also NEUTRON-NEUTRON INTERACTIONS*
**Scattering**
Recent results on polarizations and the present status of the Fermilab polarized beams, 12:38110 (R;US)

**NUTS (MECHANICAL)**
*See FASTENERS*

## O

**OAK RIDGE**
**Nature Reserves**
Resource Management Plan for the Oak Ridge Reservation: Volume 23, Oak Ridge National Environmental Research Park, Research Sites, and State Natural Areas, 12:36963 (R;US)

**OAK RIDGE GASEOUS DIFFUSION PLANT**
*See ORGDP*

**OAK RIDGE NATIONAL LABORATORY**
*See ORNL*

**OAKS**
**Age Estimation**
Dendrochronology and documents in Exeter, South West England, 12:38028 (RA;US)
**Plant Growth**
Dendrochronological study of oak trunks found in bogs in northwest Germany, 12:38025 (RA;US)
Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects), 12:37761 (RA;US)
Environmental factors involved in the growth and distribution of post oak in the southcentral United States, 12:37739 (RA;US)
Management effects in British tree-ring series, 12:37757 (RA;US)
Tree-rings and insects: the influence of cockchafers on the development of growth rings in oak trees, 12:37745 (RA;US)
**Spatial Distribution**
Environmental factors involved in the growth and distribution of post oak in the southcentral United States, 12:37739 (RA;US)

**OCCLUSION COMPLEXES**
*See CLATHRATES*

**OCCUPATIONAL DISEASES**
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)

**OCCUPATIONAL SAFETY**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
Fence: where the community and the workplace meet, 12:37889 (R;US)
Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
Health-hazard evaluation report HETA 86-223-1743, Grundy Industries, Inc., Joliet, Illinois, 12:37625 (R;US)
Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)
Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington, 12:37629 (R;US)
Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)
Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)
Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)
Health-hazard evaluation report HETA 86-403-1747, St. James Community Hospital, Butte, Montana, 12:37684 (R;US)
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma (PCBs), 12:37675 (R;US)
Health-hazard evaluation report HETA 86-277-1750, Project Orbis, Inc., New York, New York (Ethylene oxide et al.), 12:37689 (R;US)
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-043-1760, American Crystal Sugar Company, Hillsboro, North Dakota, 12:37698 (R;US)
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
Health-hazard evaluation report HETA 85-044-1761, American Crystal Sugar Company, Drayton, North Dakota, 12:37701 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
In-depth survey report: solids-materials handling project at 3M Company, Grove City, Ohio, 12:37676 (R;US)
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
Information profiles on potential occupational hazards: benzoin, 12:37633 (R;US)
NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US)
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)

Summarization of recent literature pertaining to an occupational health standard for cadmium. Final report, 12:37991 (R;US)

**OCEAN THERMAL POWER PLANTS**
**Desalination**
Simultaneous production of desalinated water and power using a hybrid-cycle OTEC plant, 12:36678 (J;US)
**Experiment Planning**
Open-cycle ocean thermal energy conversion-experimental program development, 12:36679 (BA;US)
**Power Generation**
Simultaneous production of desalinated water and power using a hybrid-cycle OTEC plant, 12:36678 (J;US)
**Research Programs**
Open-cycle ocean thermal energy conversion-experimental program development, 12:36679 (BA;US)

**OFFICE BUILDINGS**
**Air Conditioning**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Hazardous Materials**
Health-hazard evaluation report HETA 86-045-1681, 101 Marietta Tower Building, Atlanta, Georgia, 12:37623 (R;US)
NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US)
**Heating Systems**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Indoor Air Pollution**
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
NIOSH (National Institute for Occupational Safety and Health) indoor air quality in office buildings, 12:37632 (R;US)
**Man**
Indoor particle concentration and the outdoor to indoor transport. Part 4. The human effect on indoor air quality, 12:37092 (R;FI;In Finnish)
**Ventilation Systems**
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
**Working Conditions**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)

**OFF-PEAK ENERGY STORAGE**
**Electric Batteries**
Zinc-bromine battery development, 12:36946 (R;US)

**OFFSHORE DRILLING**
**Drill Pipes**
Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)

**OFFSHORE OPERATIONS**
**Environmental Impacts**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)

**OFFSHORE PLATFORMS**
*Includes gravity or fixed, floating, and towed platforms.*
Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)
**Accidents**
Safety and optimal prevention of platform accidents, 12:36413 (R;NO)
**Construction**
Progress curves for North Sea platform projects, 12:36415 (R;NO)
**Maintenance**
Safety and optimal prevention of platform accidents, 12:36413 (R;NO)

**OHMIC PLASMA HEATING**
*See JOULE HEATING*

**OHMIC RESISTANCE**
*See ELECTRIC CONDUCTIVITY*

**OIL RESIDUES**
*See PETROLEUM RESIDUES*

**OIL SANDS**
**Reverse Combustion**
Reverse combustion in asphalt ridge tar sand, 12:36468 (R;US)
**Steam Injection**
Reverse combustion in asphalt ridge tar sand, 12:36468 (R;US)

**OIL SHALE INDUSTRY**
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)

**OIL SHALE MINING**
**Room and Pillar Mining**
Improved stopping, door, and overcast construction for oil-shale mines. Open File report, June 1984-September 1986, 12:36465 (R;US)

**OIL SHALE PROCESSING PLANTS**
**A Codes**
Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)
**Computer-Aided Design**
Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)
**Computerized Simulation**
Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)
**Demonstration Plants**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)
**Environmental Impacts**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)
**Retorts**
Yield optimization of an experimental retort using the ASPEN computer code, 12:36472 (B;US)
**Socio-Economic Factors**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)

**OIL SHALE WASTE WATER**
*See OIL SHALES*
*WASTE WATER*

**OIL SHALES**
*See also BLACK SHALES*
**Comminution**
Application of laboratory results to the design of a high yield VMIS oil shale retort, 12:36471 (B;US)
**Explosive Fracturing**
Confined volume blasting experiments: Description and analysis, 12:36466 (R;US)
**Fragmentation**
A new constitutive model for fragmentation of rock under dynamic loading, 12:36467 (R;US)
**In-Situ Retorting**
Application of laboratory results to the design of a high yield VMIS oil shale retort, 12:36471 (B;US)
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
**Oil Yields**
Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)
**Particle Size**
Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier, 12:36337 (RA;US)
**Pyrolysis**
Combined gas chromatography/mass spectrometric evaluation of selected isothermally produced shale oils, 12:36475 (R;US)

Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)

**Reaction Heat**

Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)

**Research Programs**

Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)

**Retorting**

Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)

Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)

Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)

**Toxicity**

Inhalation exposure of rats to oil shale dust and diesel exhaust, 12:36476 (RA;US)

**OIL SPILL FINGERPRINTING**

*See OIL SPILLS*

**OIL SPILLS**

**Biological Effects**

Long term effects of oil on marine benthic communities in enclosures (Norway), 12:36420 (R;NO)

**Environmental Impacts**

Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)

**Pollution Control**

Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)

**Portable Equipment**

United States Coast Guard portable salvage computer. Final report, 12:36956 (R;US)

**Removal**

Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)

**OIL WELLS**

**Caustic Flooding**

Enhanced oil recovery through in-situ generated surfactants augmented by chemical injection: First annual report for the period October 1985-September 1986, 12:36380 (R;US)

Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**Directional Drilling**

Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)

Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)

**Drill Pipes**

Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)

**Flow Models**

An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)

**Flow Rate**

Short-radius lateral drilling: A completion alternative, 12:36408 (BA;US)

**Formation Damage**

An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)

New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)

**Gas Injection**

Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)

**Hydraulic Fracturing**

Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)

An analytical solution for unsteady liquid flow in a reservoir with a uniformly fractured zone around the well, 12:36406 (BA;US)

An equivalent cell block porosity and permeability concept for modeling multiphase flow in naturally fractured, lenticular reservoirs, 12:36395 (BA;US)

Coupling of production forecasting, fracture geometry requirements and treatment scheduling in the optimum hydraulic fracture design, 12:36391 (BA;US)

Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)

Dynamic etching tests aid fracture acidizing treatment design, 12:36390 (BA;US)

Hydraulic fracturing model based on a 3D closed form: Tests, analysis of fracture geometry, and containment, 12:36393 (BA;US)

In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)

Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)

Mechanical interactions in branched or subparallel hydraulic fractures, 12:36398 (BA;US)

Mechanisms controlling fracture height growth in layered media, 12:36392 (BA;US)

Modified fracture pressure decline analysis including pressure-dependent leakoff, 12:36399 (BA;US)

New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)

Observations and recommendations in the evaluation of tests of hydraulically fractured wells, 12:36405 (BA;US)

On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)

Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)

Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs, 12:36388 (B;US)

Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)

The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)

**In-Situ Combustion**

The comparative economics of thermal recovery projects, 12:36382 (R;US)

**Meetings**

Proceedings of the 1987 SPE/DOE joint symposium on low permeability reservoirs, 12:36388 (B;US)

**Microemulsion Flooding**

Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**Offshore Drilling**

Oil well drilling, labour practice, safety and environment - low mechanization level, 12:36387 (R;NO;In Norwegian)

**Production**

Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)

**Productivity**

Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)

**Propping Agents**

Long-term performance of proppants under simulated reservoir conditions, 12:36400 (BA;US)

On the stimulation of a northern North Sea tight sand, 12:36396 (BA;US)

**Resource Depletion**

Rate-sensitivity and the optimal choice of production capacity of petroleum reservoirs, 12:36371 (R;NO)

**Sonic Logging**

Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)

**Steam Injection**

Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)

Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes, 12:36377 (R;US)

The comparative economics of thermal recovery projects, 12:36382 (R;US)

**Testing**

Mathematical analysis of single-well tracer test, 12:36383 (R;US)

Observations and recommendations in the evaluation of tests of hydraulically fractured wells, 12:36405 (BA;US)

**Waterflooding**

Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery, 12:36386 (R;DE;In German)

Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**Well Drilling**

Investigation of the structure of filter cakes from bore flushing. Investigation of temperature stability of bore flushing liquids based on water. Investigation of rock drilling processes with diamond cutters of peg shape, 12:36375 (R;DE;In German)

**Well Logging**

In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)

**OIL YIELDS**

**Losses**

Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)

**OIL-EXPORTING COUNTRIES**

*For broad, general use only; if specific countries are discussed use the specific country descriptor.*

**Economic Development**

Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)

**OILS**

*See also FUEL OILS*
*MINERAL OILS*
*PYROLYTIC OILS*
*VEGETABLE OILS*

**Hydrogenation**

Catalytic hydrotreating of biomass-derived oils, 12:36592 (R;US)

**Recovery**

STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)

**OLEFINS**

*See ALKENES*

**ON-LINE COMPUTERS**

*See ON-LINE SYSTEMS*

**ON-LINE SYSTEMS**

**Performance**

On-line inspection of ferromagnetic materials using magnetic NDE methods, 12:37267 (BA;US)

**OPEN-FLOW COLLECTORS**

*See TRICKLE-TYPE COLLECTORS*

**OPERATION (REACTOR)**

*See REACTOR OPERATION*

**OPTICAL EQUIPMENT**

**Research Programs**

Fiber optic instrumentation development, 12:36305 (RA;US)

**OPTICAL FILTERS**

**Design**

Synthesis of digital holograms by direct binary search, 12:38313 (J;US)

**Fabrication**

Synthesis of digital holograms by direct binary search, 12:38313 (J;US)

**ORBITS**

*For electron orbits in atoms use ELECTRONIC STRUCTURE.*

**Numerical Solution**

Orbit extension method for finding unstable orbits, 12:38333 (R;US)

**ORELA**

*Oak Ridge Electron Linear Accelerator.*

**Beam Bunching**

Calculated fraction of an incident current pulse that will be accelerated by an electron linear accelerator and comparisons with experimental data, 12:37544 (J;NL)

**ORGANIC CHLORINE COMPOUNDS**

*See also CHLORINATED AROMATIC HYDROCARBONS*
*METHYLENE CHLORIDE*
*PHOSGENE*

**Combustion**

Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)

**Liquid Column Chromatography**

The determination of chlorophenoxy acid herbicides by liquid chromatography using carbon-14 tracers, 12:37372 (R;US)

**Waste Disposal**

Problems and progress associated with the disposal of hazardous chlorinated chemical wastes, 12:37708 (BA;US)

**ORGANIC COMPOUNDS**

*See also AMINES*
*AROMATICS*
*ESTERS*
*HETEROCYCLIC COMPOUNDS*
*HYDROCARBONS*
*KETONES*
*ORGANIC NITROGEN COMPOUNDS*
*ORGANIC OXYGEN COMPOUNDS*
*ORGANIC SULFUR COMPOUNDS*
*ORGANOMETALLIC COMPOUNDS*
*PROTEINS*

**Air Pollution Monitoring**

Modern continuous samplers for volatile organics and inorganic gases, 12:37665 (R;US)

**Chemical Analysis**

Preparation of radioactive "mixed" waste samples for measurement of RCRA [Resource Conservation and Recovery Act] organic compounds, 12:37371 (R;US)

**Detection**

Comparison study of search algorithms and data base libraries for compound identification from mass spectral data, 12:37380 (R;US)

**Mass Spectra**

Comparison study of search algorithms and data base libraries for compound identification from mass spectral data, 12:37380 (R;US)

**Photochemical Reactions**

Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)

**Pyrolysis**

Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)

**Removal**

Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)

**Volatile Matter**

Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)

Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)

Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)

VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)

**ORGANIC FLUORINE COMPOUNDS**

**Electron Attachment**

Effect of temperature on nondissociative electron attachment to molecules, 12:37388 (R;US)

**Thermal Degradation**

Materials performance analysis of perfluorocarbon liquid/plastic film capacitors, 12:37368 (BA;US)

**ORGANIC NITROGEN COMPOUNDS**

*Excluding PROTEINS, AMINES, ALKALOIDS, AMINO ACIDS, NUCLEIC ACIDS, and NUCLEOTIDES.*

*See also IMIDES*
*NITROSO COMPOUNDS*
*PORPHYRINS*

**Adducts**
Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987, 12:36272 (R;US)
**Adsorption**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**Catalytic Effects**
Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, February-April 1987, 12:36272 (R;US)
**Liquid Column Chromatography**
Pulsed-laser photothermal refraction detection in capillary liquid chromatography, 12:37385 (J,US)
**Oxidation**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane (Aminofurazans), 12:37400 (R;US)
**Structural Chemical Analysis**
Separation and characterization of coal derived components, 1 April 87-31 June 87, 12:36310 (R;US)

**ORGANIC OXYGEN COMPOUNDS**
*Excluding HYDROXY COMPOUNDS, CARBONIC ACID DERIVATIVES, LIPIDS, STEROIDS, CARBOHYDRATES, ORGANIC ACIDS, ALDEHYDES, KETONES and ESTERS.*
*See also DIOXIN*
*EPOXIDES*
*FURANS*
*QUINONES*
**Chemical Reactions**
Oxidation of heterocyclic amines, sulfilimines, and phosphine imines with dimethyldioxirane, 12:37400 (R;US)

**ORGANIC SOLVENTS**
Chelating extractants of improved selectivity: Final report, 12:37373 (R;US)
**Cleaning**
Canyon solvent cleaning (HM Process solvent), 12:36485 (R;US)
Canyon solvent cleaning with solid adsorbents (HM Process solvent (TBP in n-paraffin)), 12:36486 (R;US)
**Health Hazards**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 85-482-1730, HETA 86-116-1730, Winters Industry Foundry, Canton, Ohio, 12:37626 (R;US)
Health-hazard evaluation report HETA 85-518-1737, LCI Excelon Products, Inc., Woodland, Washington, 12:37629 (R;US)
**Vapors**
Health-hazard evaluation report HETA 86-037-1749, Lamiglas, Woodland, Washington, 12:37683 (R;US)

**ORGANIC SULFUR COMPOUNDS**
*See also POLYCYCLIC SULFUR HETEROCYCLES*
*SULFONATES*
*SULFONES*
*THIOPHENE*
*TTF*
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Synthesis**
4,5-methylenedithio-4',5'-propylenedithiotetrathiafulvalene (MPT) and 4,5-ethylenedithio-4',5'-propylenedithiotetrathiafulvalene (EPT), 12:37389 (R;US)
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Uses**
[Production and reactions of substituted dihydrofurans and thiophenes], 12:37397 (R;US)

**ORGANIC WASTES**
*See also AGRICULTURAL WASTES*
**Anaerobic Digestion**
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Enzymatic Hydrolysis**
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)

**ORGANOMETALLIC COMPOUNDS**
*For compounds of metals and semimetals with organic compounds, but only when the metal or semimetal is directly bound to carbon.*
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Synthesis**
Synthesis of organometallic compounds: Final technical report, 12:37336 (R;US)
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)

**ORGDP**
**Radioactive Waste Disposal**
Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)
**Waste Disposal**
Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)
**Water Pollution Monitors**
Monitor well installation at K-1407-B and K-1407-C surface impoundments at the Oak Ridge Gaseous Diffusion Plant, 12:36517 (R;US)

**ORNL**
**Bibliographies**
Biomedical and Environmental Sciences Programs: Publications 1986, 12:37859 (R;US)
**Geology**
Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 12:36523 (R;US)
**Hydraulic Fracturing**
Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 12:36523 (R;US)
**Radioactive Waste Disposal**
Geophysical data from boreholes DM1, DM2, DM3, and DM3a, New Hydraulic Fracturing Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 12:36523 (R;US)
**Radioactive Waste Management**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**Radioactive Waste Processing**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**Radioactive Waste Storage**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)

**OSCILLATIONS (PLASMA)**
*See PLASMA WAVES*

**OSMIUM 190**
**Energy Levels**
Ir(t-arrow-right,α)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)

**OSMIUM 192**
**Energy Levels**
Ir(t-arrow-right,$\alpha$)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)
**OVENS**
**Heat Recovery**
Low temperature heat recovery, 12:37104 (R;GB)
**OXIDANTS**
*See OXIDIZERS*
**OXIDASES**
*See OXIDOREDUCTASES*
**OXIDATION**
*See also COMBUSTION*
**Chemical Reaction Kinetics**
Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 March 1987-15 June 1987, 12:36318 (R;US)
**OXIDES**
*See also ALUMINIUM OXIDES*
*BARIUM OXIDES*
*BERYLLIUM OXIDES*
*CALCIUM OXIDES*
*COPPER OXIDES*
*IRON OXIDES*
*LANTHANUM OXIDES*
*LEAD OXIDES*
*LITHIUM OXIDES*
*MAGNESIUM OXIDES*
*MOLYBDENUM OXIDES*
*NICKEL OXIDES*
*NITROGEN OXIDES*
*SILICON OXIDES*
*STRONTIUM OXIDES*
*SULFUR OXIDES*
*THORIUM OXIDES*
*TITANIUM OXIDES*
*VANADIUM OXIDES*
*YTTRIUM OXIDES*
*ZINC OXIDES*
*ZIRCONIUM OXIDES*
**Detection**
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**Sorptive Properties**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**Superconductivity**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)
**Wave Propagation**
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**OXIDIZERS**
**Biological Effects**
Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)
**Environmental Impacts**
Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)
**OXIDIZING AGENTS**
*See OXIDIZERS*
**OXIDOREDUCTASES**
*Code number 1.*
*See also HYDROXYLASES*
*OXYGENASES*
**Catalytic Effects**
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)
**Enzyme Activity**
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)
Metabolism of gallate and phloroglucinol in Eubacterium oxidoreducens via 3-hydroxyl-5-oxohexanoate, 12:38009 (J;US)
**OXIRANS**
*See EPOXIDES*
**OXYGEN**
**Adsorption**
Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100), 12:37353 (J;US)
**Crystal Structure**
Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100), 12:37353 (J;US)
**Diffusion**
Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100), 12:37353 (J;US)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Isotope Ratio**
Model for simulating the variation in the oxygen isotope ratio in the meltwater discharge from the marginal zone of the Inland Ice at Pakitsup akuliarusersua, Jakobshavn, 12:38038 (R;DK;In Danish)
**Measuring Instruments**
The Harwell oxygen sensors: Description, operating conditions and performance, 12:37576 (R;GB)
**Raman Spectroscopy**
Application of CARS to scramjet combustion. Final report, 12:37376 (R;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**OXYGEN 16 REACTIONS**
**Heavy Ion Fusion Reactions**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**Momentum Transfer**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**Optical Models**
An optical model analysis of $^{16}O$ + $^{12}C$ elastic scattering at E/A = 94 MeV, 12:38266 (R;US)
**Reaction Kinetics**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)
**OXYGEN 16 TARGET**
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
Studies of hypernuclei by associated production, 12:38237 (R;US)
**OXYGEN 18**
**Energy Levels**
Microscopic analysis of projectile excitation for /sup 18/O+/sup 64/Ni, 12:38276 (J;US)
**OXYGEN 18 REACTIONS**
**Inelastic Scattering**
Microscopic analysis of projectile excitation for /sup 18/O+/sup 64/Ni, 12:38276 (J;US)
**OXYGEN COMPOUNDS**
*See also BORATES*
*FERRITES*
*NITRATES*
*OXIDES*
*PHOSPHATES*
*SILICATES*
*SULFATES*
*TITANATES*
*WATER*

**Titanates**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)

**OXYGEN EFFECT (RADIOBIOLOGY)**
*See OXYGEN*

**OXYGEN HYDRIDES**
*See WATER*

**OXYGEN IONS**
**Anions**
Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis, 12:38100 (R;US)

**OXYGEN PLANTS**
**Design**
Zirconia cell oxygen source, 12:36254 (RA;US)
Zirconia tape casting, 12:36256 (RA;US)
**Economics**
Zirconia cell oxygen source, 12:36254 (RA;US)
**Mathematical Models**
Zirconia cell oxygen source, 12:36254 (RA;US)
**Performance Testing**
Zirconia cell oxygen source, 12:36254 (RA;US)
Zirconia tape casting, 12:36256 (RA;US)

**OXYGENASES**
*Code number 1.13*
*See also MIXED-FUNCTION OXIDASES*
**Enzyme Activity**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
**Tissue Distribution**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)

**OXYMETHYLENE**
*See FORMALDEHYDE*

**OZONE**
**Biological Effects**
Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)
Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)
**Environmental Effects**
Effects of ozone on forests in the northeastern United States, 12:37605 (R;US)
**Environmental Impacts**
Products formed by photooxidants as factors for new types of forest decline. Results and considerations, 12:37988 (R;DE;In German)
**Production**
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
**Respiration**
Interspecies dosimetry of reactive gases, 12:37996 (R;US)
Modeling ozone absorption in the lower respiratory tract, 12:38001 (R;US)
**Toxicity**
Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California, 12:37946 (RA;US)
Effect of time of glutathione depletion on ozone-induced pulmonary fibrosis, 12:37975 (RA;US)
Effect of exogenous sources of cysteine on lung glutathione levels, 12:37982 (RA;US)
Possible role of reduced glutathione in the development of pulmonary fibrosis, 12:37974 (RA;US)
Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)
Tolerance and susceptibility to air pollution, a new direction in sampling strategy: a case study of Pinus strobus L. in Acadia National Park, Maine, 12:37945 (RA;US)
**Uptake**
Modeling ozone absorption in the lower respiratory tract, 12:38001 (R;US)

# P

**P CODES**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)

**P INVARIANCE**
Parity violation workshop: CEBAF [Continuous Electron Beam Accelerator Facility], 12:38272 (R;US)

**PACKAGING**
**Testing**
Base technology development enhances state-of-the-art in meeting performance requirements, 12:37465 (R;US)

**PACKED BED**
**Porosity**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)
**Pressure Drop**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)

**PACKINGS**
*See also COLUMN PACKING*
**Mechanical Properties**
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand (Crushed salt: bentonite = 70:30 by weight), 12:36535 (R;US)

**PAH**
*See POLYCYCLIC AROMATIC HYDROCARBONS*

**PAIR PRODUCTION**
**Spin Orientation**
Polarization density matrix for heavy Qanti Q production in hadron colliders, 12:38203 (J;NL)

**PALLADIUM**
**Catalytic Effects**
Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors, 12:37519 (J;US)
**Electronic Structure**
Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors, 12:37520 (J;US)
**Sorptive Properties**
Formation of a metastable ordered surface phase due to competitive diffusion and adsorption kinetics: Oxygen on Pd(100), 12:37353 (J;US)
Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors, 12:37520 (J;US)

**PALLADIUM ALLOYS**
**Electric Conductivity**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Kondo Effect**
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
**Relaxation**
Structural relaxation in Pd-Ge metallic glass, 12:37222 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)

**PALLADIUM COMPLEXES**
**Catalytic Effects**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)

**PANTEX PLANT**
**Environment**
Environmental monitoring report for Pantex Plant covering 1986, 12:36550 (R;US)

**PAPER INDUSTRY**
**Hazardous Materials**
Health-hazard evaluation report HETA 85-462-1748, Boise Cascade, Vancouver, Washington, 12:37678 (R;US)
**Separation Processes**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)

**PARABANIC ACID**
*See ORGANIC OXYGEN COMPOUNDS*

**PARABOLIC DISH COLLECTORS**
Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)
**Solar Heat Engines**
Liquid metal thermal electric converter, 12:36657 (R;US)
**PARABOLIC DISH REFLECTORS**
**C Codes**
CIRCE: Computer code for the analysis of point-focus solar concentrators, 12:36712 (BA;US)
**Computer Calculations**
CIRCE: Computer code for the analysis of point-focus solar concentrators, 12:36712 (BA;US)
**Computer-Aided Design**
Thermal design of new 'trumpet' secondary concentrators using computer modelling, 12:36710 (BA;US)
**Computerized Simulation**
Thermal design of new 'trumpet' secondary concentrators using computer modelling, 12:36710 (BA;US)
**Deformation**
Moderate axisymmetric deformations of optical membrane surfaces, 12:36707 (J;US)
**Design**
An assessment of the potential benefits of secondaries in point-focus concentrators, 12:36711 (BA;US)
Preliminary investigation of a lightweight inflated conical concentrator for space applications, 12:36715 (BA;US)
**H Codes**
CIRCE: Computer code for the analysis of point-focus solar concentrators, 12:36712 (BA;US)
**Mathematical Models**
An assessment of the potential benefits of secondaries in point-focus concentrators, 12:36711 (BA;US)
**Membranes**
Moderate axisymmetric deformations of optical membrane surfaces, 12:36707 (J;US)
**Optical Properties**
An assessment of the potential benefits of secondaries in point-focus concentrators, 12:36711 (BA;US)
**Performance**
CIRCE: Computer code for the analysis of point-focus solar concentrators, 12:36712 (BA;US)
**Surface Properties**
Moderate axisymmetric deformations of optical membrane surfaces, 12:36707 (J;US)
**Thermodynamics**
An assessment of the potential benefits of secondaries in point-focus concentrators, 12:36711 (BA;US)
**PARABOLIC POINT COLLECTORS**
*See PARABOLIC DISH COLLECTORS*
**PARABOLIC REFLECTORS**
*See also PARABOLIC DISH REFLECTORS*
**Defects**
Moderate to large axisymmetric deformations of optical membrane surfaces, 12:36713 (BA;US)
**Optical Equipment**
Moderate to large axisymmetric deformations of optical membrane surfaces, 12:36713 (BA;US)
**Surface Properties**
Moderate to large axisymmetric deformations of optical membrane surfaces, 12:36713 (BA;US)
**PARABOLIC TROUGH COLLECTORS**
**Antireflection Coatings**
Sol-gel AR films for solar applications, 12:37369 (BA;US)
**Computer-Aided Design**
Optimization of parabolic trough collector design for developing country applications using a closed-form expression for intercept factor, 12:36718 (BA;US)
**Thermodynamics**
Optimization of parabolic trough collector design for developing country applications using a closed-form expression for intercept factor, 12:36718 (BA;US)
**PARAFFINS**
*See ALKANES*
**PARALLEL PROCESSING**
**Algorithms**
Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis, 12:38307 (R;US)
Coherent VLSI environment. Semiannual technical report, 1 October 1986-31 March 1987, 12:38402 (R;US)
Optimal partitioning and redundancy removal in computing partial sums. Technical report (Final) December 1985-January 1987, 12:38405 (R;US)
**Computer Architecture**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)
Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)
Performance evaluation of parallel branch and bound search with the Intel IPSC (Intel Personal Supercomputer) hypercube computer. Master's thesis, 12:38403 (R;US)
**PARAMAGNETIC RESONANCE (NUCLEAR)**
*See NUCLEAR MAGNETIC RESONANCE*
**PARAMAGNETISM**
**Band Theory**
Optical properties of iron and dilute iron-aluminum alloys, 12:37274 (D;US)
**PARITY NONCONSERVATION**
*See P INVARIANCE*
**PARKS (INDUSTRIAL)**
*See INDUSTRIAL PARKS*
**PARTICLE BEAM FUSION ACCELERATOR**
**Research Programs**
Progress in light ion beam fusion research on PBFA II, 12:38390 (J;GB)
**PARTICLE BOOSTERS**
*First stages of a multistage accelerator.*
**Computerized Simulation**
Simulation of space charge effects and transition crossing in the Fermilab Booster, 12:37543 (R;US)
**Space Charge**
Simulation of space charge effects and transition crossing in the Fermilab Booster, 12:37543 (R;US)
**PARTICLE SIZE CLASSIFIERS**
**Design**
In situ real-time analysis of particulates, 12:36355 (RA;US)
**Optimization**
In-situ particle characterization, 12:36307 (RA;US)
**Performance Testing**
In situ real-time analysis of particulates, 12:36355 (RA;US)
**PARTICLE TRACKS**
**Data Acquisition Systems**
Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)
**PARTICLES**
*When appropriate use more specific terms listed under CHARGED PARTICLES, ELEMENTARY PARTICLES, and QUASI PARTICLES.*
*See also PARTICULATES*
**Indoor Air Pollution**
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**Sampling**
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
Levels of dusts, bacteria and fungal spores in houses and daycare centers with forced air heating system and at some complain sites, 12:37090 (R;FI;In Finnish)
**PARTICULATES**
*Prior to September 1981, this concept was indexed to PARTICLES and AEROSOLS.*
**Air Pollution Abatement**
Control of atmospheric fine primary carbon particle concentrations. Final report, 12:37654 (R;US)
**Air Pollution Control**
Electrostatic precipitator guidelines: Volume 2, Operations and maintenance: Final report, 12:37609 (R;US)
**Chemical Composition**
Characteristics of radioactive particles released from the Chernobyl nuclear reactor, 12:36832 (RA;US)

**Compression Strength**
Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986 (Two-phase granules held together by surface tension), 12:36354 (R;US)
**Corrosive Effects**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Deposition**
Characteristics of radioactive particles released from the Chernobyl nuclear reactor, 12:36832 (RA;US)
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)
**Electrostatic Precipitators**
Comparison of electrostatic-precipitator performance with pulse and d-c energization, 12:37668 (R;US)
**Health Hazards**
Air-Quality Criteria for Particulate Matter and Sulfur Oxides (1982) (second addendum): assessmet of newly available health-effects information. Final report, 12:37642 (R;US)
**Heating**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**Indoor Air Pollution**
Health-hazard evaluation report HETA 83-162-1746, Handy and Harman, Inc., Fairfield, Connecticut, 12:37680 (R;US)
Health-hazard evaluation report HETA 85-306-1753, Timken, Inc., Canton, Ohio, 12:37692 (R;US)
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)
Health-hazard evaluation report HETA 85-046-1763, American Crystal Sugar Company, East Grand Forks, Minnesota, 12:37697 (R;US)
Health-hazard evaluation report HETA 85-045-1762, American Crystal Sugar Co., Crookston, Minnesota, 12:37702 (R;US)
**Inhalation**
Model analysis of respiratory tract clearance of particles inhaled by people, 12:37970 (RA;US)
**Kinetics**
Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986 (Two-phase granules held together by surface tension), 12:36354 (R;US)
**Lung Clearance**
Model analysis of respiratory tract clearance of particles inhaled by people, 12:37970 (RA;US)
**Measuring Methods**
Drag force and slip correction factor of aggregates measured in a Millikan apparatus, 12:37613 (RA;US)
Particle evolution in MHD systems, 12:37005 (R;US)
**Membrane Transport**
Translocation of particles by macrophages from lung to lymph nodes of rats, 12:37964 (RA;US)
**Morphology**
Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces, 12:36321 (J;US)
**Particle Size**
Cigarette smoke aerosol in a Walton smoke machine, 12:37614 (RA;US)
Morphology and size distribution of atmospheric particles deposited on foliage and inert surfaces, 12:36321 (J;US)
**Removal**
Parameter monitoring for real-time electrostatic precipitator trouble shooting. Report for March-August 1985, 12:37652 (R;US)
**Retention**
Translocation of particles by macrophages from lung to lymph nodes of rats, 12:37964 (RA;US)
**Sorptive Properties**
Rapid heating of gas/small particle mixture, 12:37410 (J;US)
**Standards**
Review of the national ambient air-quality standards for particulate matter: updated assessment of scientific and technical information. Addendum to the 1982 OAQPS (Office of Air Quality Planning and Standards) staff paper. Final report, 12:37727 (R;US)
**Sulfates**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**Tensile Properties**
Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period October 1-December 31, 1986 (Two-phase granules held together by surface tension), 12:36354 (R;US)
**PASSIVE SOLAR HEATING SYSTEMS**
**Thermal Efficiency**
Determination of R-values from in-situ dynamic thermal test data in light weight roof systems, 12:36690 (BA;US)
**PATHOLOGICAL CHANGES**
**Monitoring**
Problems in the planning of forest damage inventories, 12:37801 (RA;DE)
**Symptoms**
Thinning out of the tree crown - what is hidden in that integrated measure of forest damage, 12:37939 (RA;DE)
**PBFA**
*See PARTICLE BEAM FUSION ACCELERATOR*
**PBR REACTOR**
**Design**
Particle Bed Reactor scaling relationships, 12:36784 (R;US)
**Uses**
Particle Bed Reactor scaling relationships, 12:36784 (R;US)
**PCB**
*See CHLORINATED AROMATIC HYDROCARBONS*
**PEAT**
**Bulk Density**
Hydrogeological studies of peatlands at Haerjedalen, 12:36345 (R;SE;In Swedish)
**Cost**
Combined systems sod peat - milled peat, 12:36344 (R;SE;In Swedish)
**Drying**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Energy Sources**
Combined systems sod peat - milled peat, 12:36344 (R;SE;In Swedish)
**Fluidization**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Gasification**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**Moisture**
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
**Prospecting**
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
**Pyrolysis**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**PEATLANDS**
*See WETLANDS*
**PEBBLE BED REACTORS**
**Fuel Elements**
Tests of candidate materials for particle bed reactors, 12:36780 (R;US)
**Reactor Control Systems**
Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
**Reactor Cores**
Thermal-hydraulic considerations for particle bed reactors, 12:36781 (R;US)

**Reactor Materials**
Tests of candidate materials for particle bed reactors, 12:36780 (R;US)
**Reactor Start-Up**
Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
**PELLET INJECTION**
**Experiment Planning**
Pellet injector research at ORNL, 12:38372 (R;US)
**PELLETIZING**
**Binders**
A humic acid binder for pelletizing of fine coal, 12:36230 (R;US)
**PELLETRON ACCELERATORS**
**Beam Bunchers**
Recent electronic improvements to the Oak Ridge 25URC accelerator, 12:37547 (R;US)
**Beam Monitors**
Recent electronic improvements to the Oak Ridge 25URC accelerator, 12:37547 (R;US)
**Power Supplies**
Recent electronic improvements to the Oak Ridge 25URC accelerator, 12:37547 (R;US)
**PELLETRONS**
*See PELLETRON ACCELERATORS*
**PELLETS (FUEL)**
*See FUEL PELLETS*
**PENICILLIN**
**Production**
Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
**Purification**
Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
**PEOPLE**
*See HUMAN POPULATIONS*
**PEOPLES REPUBLIC OF CHINA**
*See CHINA*
**PERSONNEL**
*Studies of groups of persons employed in a particular field of endeavor. For studies on individuals in a group see also MAN.*
*See also DIAL PAINTERS*
*MILITARY PERSONNEL*
*REACTOR OPERATORS*
**Identification Systems**
A performance evaluation of personnel identity verifiers, 12:36567 (R;US)
**Mortality**
Mortality among uranium enrichment workers, 12:36480 (R;US)
**Occupational Safety**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Protective Clothing**
Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
**Thermal Comfort**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Training**
Pressure safety training for a large research and development facility, 12:38017 (R;US)
**Working Conditions**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**PERSONNEL MONITORING**
Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring, 12:36555 (R;US)
**PESTICIDES**
*See also HERBICIDES*
*INSECTICIDES*
**Cadmium Compounds**
Cadmium technical support document, 12:37995 (R;US)
**PETROCHEMICAL FEEDSTOCKS**
*See CHEMICAL FEEDSTOCKS*
**PETROCHEMICAL PLANTS**
**Heat Exchangers**
A T-H method for heat exchanger network synthesis, 12:36412 (J;US)
**PETROLEUM**
*Limited to crude oil; see also COAL LIQUIDS, SHALE OIL, etc.*
**Biodegradation**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**Combustion**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Dissolution**
Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Enhanced Recovery**
Solving two problems of oil and gas exploitation by the generalized maximum principle, 12:36385 (R;DK)
**Evaporation**
Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)
**Exports**
Economic development under the influence of oil exports: The Nigerian example, 12:36985 (R;DE)
**Extraction**
Biodegradation of oil on cuttings - I, 12:36422 (R;NO)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Gasification**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Imports**
Kalman-filter estimation of monthly US oil imports, 12:36418 (J;GB)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Marketing**
Petroleum marketing monthly, April 1987, 12:36417 (R;US)
**Pollution Control**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**Prices**
Petroleum marketing monthly, April 1987, 12:36417 (R;US)
Transportation energy outlook under conditions of persistently low petroleum prices, 12:36416 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
The petroleum resources of China, 12:36381 (R;US)
**Taxes**
Petroleum taxes and optimal resource recovery, 12:36414 (R;NO)
**Transport**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
**PETROLEUM COKE**
*See COKE*
*PETROLEUM PRODUCTS*
**PETROLEUM DEPOSITS**
*See also GAS CONDENSATE FIELDS*
**Computerized Simulation**
Petroleum taxes and optimal resource recovery (Maximizing return to producer after taxes), 12:36414 (R;NO)

**Exploitation**
Petroleum taxes and optimal resource recovery (Maximizing return to producer after taxes), 12:36414 (R;NO)

**PETROLEUM INDUSTRY**
**Maritime Transport**
Arctic deployment of USCGC Polar Sea - winter 1983. Volume 3. Trafficability tests. Final report, December 1982-November 1983, 12:36424 (R;US)
**Offshore Operations**
Workshop to assess possible systems for tracking large cetaceans held at Seattle, Washington on 24-26 February 1987. Workshop report, 12:37835 (R;US)
**Oil Spills**
Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)
**Organic Compounds**
VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)
**Production**
International Energy Statistical Review. Monthly report, 12:36986 (R;US)
**Separation Processes**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
**Waste Management**
Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document, 12:37816 (R;US)

**PETROLEUM PRODUCTS**
*See also DIESEL FUELS*
*FUEL OILS*
*GASOLINE*
*KEROSENE*
*LIQUEFIED PETROLEUM GASES*
**Combustion Products**
Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Marketing**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)

**PETROLEUM REFINERIES**
**Air Pollution**
Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
**Competition**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Economic Analysis**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)
**Health Hazards**
Evaluation of the carcinogenicity of unleaded gasoline, 12:38002 (R;US)
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**Systems Analysis**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)

**PETROLEUM RESIDUES**
*B.P. over 1100°F, 593°C; includes oil residues, residua.*
**Refining**
Catalytic coprocessing: Effect of catalyst type and sequencing, 12:36281 (J;US)

**PETT**
*See POSITRON COMPUTED TOMOGRAPHY*

**PFR REACTOR**
**Fuel Pins**
Transient survivability of LMR oxide fuel pins, 12:36820 (R;US)

**PHARMACEUTICALS**
*See DRUGS*

**PHASE CHANGE MATERIALS**
*Use with the specific phase change material (e.g. calcium chloride) when known.*
**Latent Heat Storage**
Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)
**Tanks**
Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)

**PHASE DIAGRAMS**
**Computer Calculations**
Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Annual report, 1 March 1986-27 February 1987, 12:37279 (R;US)

**PHASE STUDIES**
**Equations of State**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)

**PHENANTHRENE**
**Ecological Concentration**
Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University, 12:37619 (RA;US)
**Solubility**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)

**PHENOLS**
*See also CRESOLS*
**Alkylation**
Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne premium coal sample, 12:36297 (R;US)
**Chemical Reaction Yield**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**Chromatography**
Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985, 12:37377 (R;US)
**Gas Chromatography**
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
**Indoor Air Pollution**
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)

**PHENYLAMINE**
*See ANILINE*

**PHILIPPINES**
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**Rural Areas**
Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation), 12:36590 (R;US)

**PHOSGENE**
**Toxicity**
Species comparison of acute inhalation toxicity of ozone and phosgene, 12:37993 (R;US)

**PHOSPHATE GLASS**
**Crystallization**
Structural nature of the amorphous-to-crystalline transition in phosphate glasses as studied by liquid chromatography, 12:37331 (R;US)
**PHOSPHATE MINERALS**
**Geologic Deposits**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
**Surface Mining**
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**PHOSPHATES**
*For salts only; see also PHOSPHORIC ACID ESTERS.*
*See also LEAD PHOSPHATES*
*URANIUM PHOSPHATES*
**Ionic Conductivity**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)
**PHOSPHORUS**
**Catalytic Effects**
Effect of phosphorus on the activity of Ni-Mo/alumina coal-liquid upgrading catalysts, 12:36279 (J;US)
**Uptake**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)
**PHOSPHORUS COMPOUNDS**
*See also PHOSPHATES*
**Chemical Preparation**
Precipitation of PZT and PLZT powders using a continuous reactor, 12:37314 (BA;US)
**Precipitation**
Precipitation of PZT and PLZT powders using a continuous reactor, 12:37314 (BA;US)
**PHOTOACOUSTIC SPECTROSCOPY**
**Performance Testing**
Laser-based infrared spectroscopy for trace analysis of process streams, 12:36303 (RA;US)
**PHOTODISINTEGRATION**
*See PHOTONUCLEAR REACTIONS*
**PHOTOELECTROCHEMICAL CELLS**
**Catalysis**
Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986, 12:36578 (R;US)
**Electrolytes**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**PHOTOLYSIS**
**Catalysts**
Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)
**PHOTOMAGNETIC EFFECT**
*See VISIBLE RADIATION*
**PHOTOMAGNETOELECTRIC EFFECT**
*See MAGNETIC FIELDS*
**PHOTON ACTIVATION ANALYSIS**
*See PHOTONS*
**PHOTON-PROTON INTERACTIONS**
**Inclusive Interactions**
Inclusive charged and neutral pion photoproduction at 20 GeV, 12:38119 (R;US)
**PHOTONS**
**Particle Production**
Bound on the number of neutrinos from $e^+ e^- \rightarrow \gamma$ upsilon anti upsilon at PEP and PETRA, 12:38128 (RA;US)
Physics from PEP, 12:38134 (RA;US)
**PHOTONUCLEAR REACTIONS**
**Pair Production**
Calculation of pair production by 10 and 20 MeV photons, 12:38275 (J;US)
**PHOTOSYNTHESIS**
**Biological Indicators**
New analysis of branches, boles, and roots for predicting historical changes in photosynthesis, respiration, and carbon allocation below ground, 12:37733 (RA;US)
**Electron Transfer**
Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules, 12:36622 (R;US)
**Research Programs**
Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987, 12:37435 (R;US)
**PHOTOSYNTHETIC BACTERIA**
**Genetic Engineering**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**Genetic Mapping**
Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report for the period June 5, 1986-June 4, 1987, 12:37862 (R;US)
**PHOTOSYNTHETIC REACTION CENTERS**
**Electron Transfer**
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
**Structure-Activity Relationships**
Photoinduced electron transfer across fixed distances in chlorophyll donor-acceptor molecules, 12:36623 (R;US)
**PHOTOVOLTAIC CELLS**
*See also SOLAR CELLS*
**Environmental Impacts**
An environmental source book on the photovoltaics industry, 12:36958 (R;US)
**PHOTOVOLTAIC POWER PLANTS**
**Performance**
SMUDPV2 quarterly performance report IV for the period January through March 1987, 12:36649 (R;US)
**Solar Tracking Systems**
Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1, 12:36647 (R;US)
**Wind Loads**
Delphos project - Wind actions on a parallel-rope tensio-structure for photovoltaic systems, 12:36645 (R;IT;In Italian)
**PHOTOVOLTAIC POWER SUPPLIES**
Water pumping: The solar alternative, 12:36648 (R;US)
**Computer-Aided Design**
Some applications of recent R and D experiences in the sizing of stand-alone photovoltaic power systems, 12:36652 (BA;US)
**Design**
Designing photovoltaic systems, 12:36653 (BA;US)
**Failure Mode Analysis**
Lessons learned and issues raised at the Sky Harbor photovoltaic project, 12:36650 (BA;US)
**Interconnected Power Systems**
Designing photovoltaic systems, 12:36653 (BA;US)
**Operation**
Operational experience with grid-connected photovoltaic systems, 12:36651 (BA;US)
**P Codes**
Some applications of recent R and D experiences in the sizing of stand-alone photovoltaic power systems, 12:36652 (BA;US)
**Performance**
Lessons learned and issues raised at the Sky Harbor photovoltaic project, 12:36650 (BA;US)
Operational experience with grid-connected photovoltaic systems, 12:36651 (BA;US)
Some applications of recent R and D experiences in the sizing of stand-alone photovoltaic power systems, 12:36652 (BA;US)
**Planning**
Designing photovoltaic systems, 12:36653 (BA;US)
**Quality Assurance**
Lessons learned and issues raised at the Sky Harbor photovoltaic project, 12:36650 (BA;US)

**PHYSICAL PROTECTION DEVICES**
SIR-1: An autonomous mobile sentry robot, 12:36570 (R;US)
**PHYSICAL RADIATION EFFECTS**
**Kinetics**
Kinetic theory of radiation effects, 12:37207 (R;US)
**Mathematical Models**
Kinetic theory of radiation effects, 12:37207 (R;US)
**PIGE ANALYSIS**
*See PROTON REACTIONS*
**PIGMENT CELLS**
*See ANIMAL CELLS*
**PIGS**
*See SWINE*
**PINES**
**Biological Stress**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
Fire history of lodgepole pine of Mt. San Jacinto, California, 12:37746 (RA;US)
**Mortality**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Plant Growth**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Carbon-13/carbon-12 variations in bristlecone pine over the past 600 years and their relation to climate and global atmospheric $CO_2$, 12:37604 (RA;US)
Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects), 12:37761 (RA;US)
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California, 12:37946 (RA;US)
Factors affecting the growth response of ponderosa pine to prescribed burning, 12:37756 (RA;US)
Growth-rate trends of pines since 1930 in the northeastern United States, 12:37944 (RA;US)
Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)
Tolerance and susceptibility to air pollution, a new direction in sampling strategy: a case study of Pinus strobus L. in Acadia National Park, Maine, 12:37945 (RA;US)
**Population Dynamics**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Productivity**
Monitoring the growth and health of white pine in New Hampshire, 12:37784 (RA;DE)
**Sensitivity**
Detecting the effects of ozone pollution of growth of Jeffrey pine in the Sierra Nevada, California, 12:37946 (RA;US)
Tolerance and susceptibility to air pollution, a new direction in sampling strategy: a case study of Pinus strobus L. in Acadia National Park, Maine, 12:37945 (RA;US)
**PINNING FORCE**
*See MAGNETIC FLUX*
**PION MINUS REACTIONS**
**Inclusive Interactions**
Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)
**PION PLUS REACTIONS**
**Absorption**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Charge-Exchange Reactions**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Elastic Scattering**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Inelastic Scattering**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Optical Models**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Quasi-Elastic Scattering**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**PIONS**
**Photoproduction**
Inclusive charged and neutral pion photoproduction at 20 GeV, 12:38119 (R;US)
**PIPE RESTRAINTS**
*See RESTRAINTS*
**PIPELINE QUALITY GAS**
*See HIGH BTU GAS*
**PIPELINES**
**Computerized Simulation**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
**Construction**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Environmental Impacts**
New techniques to minimize environmental impact to right-of-way during pipeline construction, 12:36459 (BA;US)
**Erosion**
Reduction of erosion in elbows due to flow field modifications, 12:36347 (RA;US)
**Flow Models**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
**Friction Factor**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
**Hydraulic Transport**
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**Oil Spills**
Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)
**Steels**
Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
**Two-Phase Flow**
Consistent flow regime map and friction factors for two-phase flow, 12:36426 (B;US)
Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
**PIPES**
*See also DRILL PIPES*
**Calculation Methods**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**Crack Propagation**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Electroslag Casting**
Electroslag component casting, 12:36250 (RA;US)
**Fracture Mechanics**
Degraded Piping Program: Phase 2, Semiannual report, April 1986-September 1986, 12:36804 (R;US)

**Impact Tests**
Pipe-to-pipe impact program, 12:36778 (R;US)
**Intergranular Corrosion**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
**Leak Testing**
Acoustic leak detection for district heating systems: Results of Phase 1: Laboratory assessment, 12:37153 (R;US)
**Moisture**
Effects of exposure testing on pipe insulation, 12:36692 (BA;US)
**Research Programs**
Containment and piping research, 12:36890 (RA;US)
**Seismic Effects**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**Strains**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**Stress Corrosion**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Temperature Effects**
Effects of exposure testing on pipe insulation, 12:36692 (BA;US)
**Thermal Insulation**
Effects of exposure testing on pipe insulation, 12:36692 (BA;US)
**Two-Phase Flow**
Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend, 12:36854 (RA;US)
**Ultrasonic Testing**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)

**PITCHES**
**Aerosols**
Health-hazard evaluation report HETA 85-416-1742, Roofing and Waterproofing Sites, Chicago, Illinois, 12:37890 (R;US)

**PLANETARY EVOLUTION**
**Mathematical Models**
Collisional dynamics of perturbed particle disks in the solar system. Annual technical progress report, 12:38061 (R;US)

**PLANETS**
*See also MERCURY PLANET*
**Research Programs**
Research in planetary studies and operation of the Mauna Kea Observatory. Semiannual progress report, January-December 1986, 12:38063 (R;US)

**PLANT DISEASES**
Effects of acid precipitation on plant diseases, 12:37999 (R;US)
**Meetings**
Bilateral information meeting Hungary-Austria, subject 'forest decline', 12:37989 (R;DE;In German)

**PLANT FOSSILS**
*See FOSSILS*

**PLANT GROWTH**
**Mathematical Models**
Dendroclimatological approach to the ecology of Quercus pubescens Willd. and Pinus silvestris L. in the French Mediterranean area (Methodological aspects), 12:37761 (RA;US)
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)
**Temperature Effects**
Influence of temperature and soil moisture on the radial growth of northern hardwood tree species at Hubbard Brook Experimental Forest, New Hampshire, USA, 12:37736 (RA;US)

**PLANT TISSUES**
**Environmental Exposure Pathway**
Effects of acid precipitation on plant diseases, 12:37999 (R;US)

**PLANTS**
*See also CONIFERS*
*EUPHORBIA*
*GRASS*
*LEGUMINOSAE*
*SHRUBS*
*TREES*
**Carbon Cycle**
Carbon and carbon metabolism in the environment, 12:37905 (R;DE)
**Infectious Diseases**
Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions, 12:37865 (J;US)

**PLANTS (INDUSTRIAL)**
*See INDUSTRIAL PLANTS*

**PLANTS (POWER)**
*See POWER PLANTS*

**PLASMA**
*See also COLD PLASMA*
*COLLISIONAL PLASMA*
*COLLISIONLESS PLASMA*
*HIGH-BETA PLASMA*
*HOT PLASMA*
*INHOMOGENEOUS PLASMA*
*LASER-PRODUCED PLASMA*
*LOW-BETA PLASMA*
*SOLID-STATE PLASMA*
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
**Advection**
Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence, 12:38349 (R;US)
**Atom Transport**
Measurement of the local particle diffusion coefficient in a magnetized plasma, 12:38357 (J;US)
**Bibliographies**
Plasma physics abstracts, 1 January - 31 December, 1986, 12:38343 (R;US)
**Current-Drive Heating**
Anomalous current penetration and oscillating current drive in tokamaks, 12:38359 (J;US)
**Dispersion Relations**
Symmetry properties of a multidimensional dispersion functional, 12:38363 (J;US)
**Electron Plasma Waves**
Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
**Heat Flux**
Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence, 12:38349 (R;US)
**Joule Heating**
Resistive-heating instability of a compressible, force-free plasma, 12:38362 (J;US)
**Neutral-Particle Transport**
Vectorizing and macrotasking Monte Carlo neutral particle algorithms, 12:38352 (R;US)
**Nonlinear Problems**
Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
**Plasma Diagnostics**
Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
**Plasma Pressure**
Resistive-heating instability of a compressible, force-free plasma, 12:38362 (J;US)
**Raman Effect**
Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
**Tearing Instability**
Resistive-heating instability of a compressible, force-free plasma, 12:38362 (J;US)
**Turbulent Flow**
Rigorous upper bounds for transport due to passive advection by inhomogeneous turbulence, 12:38349 (R;US)

PLASMA DIAGNOSTICS
Ion Beams
Measurement of the local particle diffusion coefficient in a magnetized plasma, 12:38357 (J;US)
Magnetic Probes
Plasma formation and equilibrium in a high $\beta$ tokamak, 12:38361 (J;US)
Optical Spectrometers
Measurement of the local particle diffusion coefficient in a magnetized plasma, 12:38357 (J;US)
Ruby Lasers
Observation of steepening in electron plasma waves driven by stimulated Raman backscattering, 12:38365 (J;US)
X-Ray Spectrometers
High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics, 12:38347 (R;US)
PLASMA INSTABILITY
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)
Instability Growth Rates
Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
Ion Acoustic Waves
Electron heating by ion acoustic turbulence in simulated low Mach number shocks, 12:38364 (J;US)
N Codes
NOVA: A nonvariational code for solving the MHD stability of axisymmetric toroidal plasmas, 12:38366 (J;US)
PLASMA OSCILLATIONS
*See PLASMA WAVES*
PLASMA SHEET
Ion Drift
Generation of broadband noise in the magnetotail, 12:38081 (R;US)
PLASMA SIMULATION
Solution to workshop problem 6 (hollow sphere) in the shell approximation with EDDYNET-2D, 12:38322 (R;US)
Numerical Solution
Direct implicit electromagnetic plasma simulation, 12:38356 (R;US)
PLASMA WAVES
Plasma theory and simulation. Quarterly progress report Nos. 3 and 4, 1 July-31 December 1985, 12:38319 (R;US)
Bibliographies
Plasma physics abstracts, 1 January - 31 December, 1986, 12:38343 (R;US)
PLASTIC FOAMS
Thermal Expansion
Thermal expansion of low-density microcellular foams, 12:37351 (R;US)
PLASTICS
*See also ARAMIDS*
*MYLAR*
*PLEXIGLAS*
*TEFLON*
*THERMOPLASTICS*
Recycling
The economic feasibility of plastics recycling, 12:37129 (R;US)
PLASTICS INDUSTRY
Hazardous Materials
Health-hazard evaluation report HETA 84-458-1733, HETA 84-489-1733, Schlegel, Incorporated, Rochester, New York, 12:37630 (R;US)
Occupational-hazard control options for chemical process unit operations, preliminary survey report for the site visit of October 19, 1981 to Borg-Warner Chemicals Woodmar Plant, Washington, West Virginia, 12:37627 (R;US)
PLATES
*Thicker than SHEETS or FOILS.*
Turbulent Flow
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer. Final report, 12:37496 (R;US)
PLATINUM ALLOYS
Superconductivity
Mass renormalizations and superconductivity in heavy-fermion $UPt_3$, 12:37252 (J;US)
PLATINUM COMPLEXES
Catalytic Effects
Low severity coal conversion by ionic hydrogenation: [Progress report], April 1 to June 30, 1987, 12:36270 (R;US)
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
PLATINUM COMPOUNDS
Crystal Structure
YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)
Electric Conductivity
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
Magnetic Susceptibility
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
PLESIOTHERAPY
*See RADIOTHERAPY*
PLEXIGLAS
Wave Propagation
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)
PLUM BROOK NASA-TR
*See PBR REACTOR*
PLUM BROOK REACTOR FACILITY
*See PBR REACTOR*
PLUMES
Gas Analysis
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
PLUTONIUM
Chemical Preparation
[Small scale direct oxide reduction (DOR) experiments], 12:36491 (R;US)
Electrorefining
Design and evaluation of plutonium electrorefining cells, 12:36484 (R;US)
Recovery
Aqueous methods for recovery of plutonium from pyrochemical residues, 12:36490 (R;US)
Recovery of transuranics from process residues, 12:36513 (R;US)
Uptake
Interactions of plutonium and americium with bone mineral, 12:37907 (RA;US)
PLUTONIUM 238
Inhalation
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
Toxicity
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 $\mu$ AMAD particles. B. Monodisperse 3.0 $\mu$m particles. XIII, 12:37918 (RA;US)
PLUTONIUM 239
Air Pollution Monitoring
Evaluation of an L-shell X-ray based continuous air monitor for airborne plutonium for use in the waste isolation pilot plant, 12:37716 (RA;US)
Inhalation
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
Radioecological Concentration
Evaluation of an L-shell X-ray based continuous air monitor for airborne plutonium for use in the waste isolation pilot plant, 12:37716 (RA;US)
Retention
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)

**Toxicity**
Cardiopulmonary function of dogs with plutonium-induced chronic lung injury, 12:37924 (RA;US)
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxicity of inhaled alpha-emitting radionuclides - status report, 12:37917 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX, 12:37919 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII, 12:37921 (RA;US)

**PLUTONIUM 244**
**Abundance**
The early solar system abundance of $^{244}Pu$ as inferred from the St. Severin chondrite, 12:38070 (R;US)

**PNA**
*See POLYCYCLIC AROMATIC HYDROCARBONS*

**PNEUMONITIS**
**Radioinduction**
Cardiopulmonary function of dogs with plutonium-induced chronic lung injury, 12:37924 (RA;US)
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII, 12:37912 (RA;US)
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 μ AMAD particles. B. Monodisperse 3.0 μm particles. XIII, 12:37918 (RA;US)
Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AMAD particles. B. Monodisperse 1.5 μm AMAD particles. C. Monodisperse 3.0 μm AMAD particles. IX, 12:37919 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VIII, 12:37921 (RA;US)

**POINT CONTACTS**
*See ELECTRIC CONTACTS*

**POINT KERNELS**
**Calculation Methods**
New buildup factor data for point kernel calculations, 12:38291 (R;US)

**POINT MUTATIONS**
*See GENE MUTATIONS*

**POISEUILLE FLOW**
*See LAMINAR FLOW*

**POISONS (CHEMICAL)**
*See HAZARDOUS MATERIALS*

**POISSON RATIO**
**Experimental Data**
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand (Crushed salt: bentonite = 70:30 by weight), 12:36535 (R;US)

**POLARIZED BEAMS**
**Research Programs**
Recent results on polarizations and the present status of the Fermilab polarized beams, 12:38110 (R;US)

**POLICY**
*See ENERGY POLICY*
*ENVIRONMENTAL POLICY*

**POLLUTION**
*See also AIR POLLUTION*
*LAND POLLUTION*
*NOISE POLLUTION*
*WATER POLLUTION*
**Biological Indicators**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Potentials and limitations of dendrochronology in pollution research, 12:37806 (RA;US)
**Toxicity**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)

**POLLUTION CONTROL**
*Use this term for items that involve the removal or management of pollutants after they are formed by a source.*
*See also AIR POLLUTION CONTROL*
**Bench-Scale Experiments**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**Management**
Executive summary of long-range environmental management plans: FY 1987-1993, 12:36960 (R;US)
**Petroleum**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**Surfactants**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)

**POLLUTION CONTROL AGENCIES**
**Administrative Procedures**
Handbook for the review of excess emission reports. Final report, 12:37681 (R;US)

**POLLUTION CONTROL EQUIPMENT**
*See also ELECTROSTATIC PRECIPITATORS*
*SCRUBBERS*
**Filters**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**Materials Recovery**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**Measuring Instruments**
Opening remarks: instrumentation, components, and materials contractors meeting, 12:36242 (RA;US)
**Retrofitting**
Estimating performance/costs of retrofitting control technologies at 12 coal-fired power plants. Report for November 1985-February 1987, 12:36761 (R;US)

**POLYCARBONATES**
**Thermal Degradation**
Materials performance analysis of perfluorocarbon liquid/plastic film capacitors, 12:37368 (BA;US)

**POLYCYCLIC AROMATIC HYDROCARBONS**
*See also 3-METHYLCHOLANTHRENE*
**Chemical Reaction Yield**
Gas-phase intramolecular Diels-Alder reactions of 2,3-dimethylene-2,3-dihydrofurans; Formation of 9-methylanthracene and anthracene by pyrolysis; and preparation of cyclopentadienones by flash vacuum pyrolysis, 12:37398 (R;US)
**Ecological Concentration**
Physical and chemical characterization of the process stream for a commercial scale fluidized bed combustor at the East Stroudsburg University, 12:37619 (RA;US)
**Genetic Effects**
Effect of irradiation on unscheduled DNA synthesis induced by 4-nitroquinoline in tracheal epithelium of rats, 12:37929 (RA;US)
**Hydrogenation**
Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)
**Inhalation**
Lung retention of inhaled $^{14}C$-BaP and $^{14}C$-NP when adsorbed on carbon particles, 12:37967 (RA;US)
**Metabolism**
Detection of DNA adducts formed from metabolites of 1-nitropyrene and 1-8-dinitropyrene in vitro, 12:37980 (RA;US)

Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
Formation of DNA adducts in mouse tissues after 1-nitropyrene administration, 12:37981 (RA;US)
Physiologically based model 1-nitropyrene metabolism, 12:37969 (RA;US)
**Molecular Structure**
Studies of metal ammonia interactions with aromatic substrates: Progress report for the period February 1, 1987 to December 31, 1987, 12:37394 (R;US)
**Reduction**
Studies of metal ammonia interactions with aromatic substrates: Progress report for the period February 1, 1987 to December 31, 1987, 12:37394 (R;US)
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Retention**
Lung retention of inhaled $^{14}$C-BaP and $^{14}$C-NP when adsorbed on carbon particles, 12:37967 (RA;US)
**Tissue Distribution**
Physiologically based model 1-nitropyrene metabolism, 12:37969 (RA;US)

**POLYCYCLIC SULFUR HETEROCYCLES**
**Catalysts**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**Desulfurization**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**Hydrogenation**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)

**POLYETHERS**
*See POLYETHYLENE GLYCOLS*

**POLYETHYLENE GLYCOLS**
**Synthesis**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)
**Uses**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)

**POLYETHYLENE OXIDES**
*See POLYETHYLENE GLYCOLS*

**POLYETHYLENES**
*See also POLYTETRAFLUOROETHYLENE*
**Aging**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**Dielectric Properties**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**Failure Mode Analysis**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)

**POLY(ISOBUTYLENE OXIDE)**
*See EPOXIDES*

**POLYMER FLOODING**
*See MICROEMULSION FLOODING*
*WATERFLOODING*

**POLYMERS**
**Decomposition**
Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery (Xanthane, sceleroglucane, hydroxyethyl cellulose), 12:36386 (R;DE;In German)
**Performance**
Polymer emulsion: The revival of a fracturing fluid, 12:36401 (BA;US)
**Stability**
Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery (Xanthane, sceleroglucane, hydroxyethyl cellulose), 12:36386 (R;DE;In German)

**POLYNUCLEAR AROMATIC HYDROCARBONS**
*See POLYCYCLIC AROMATIC HYDROCARBONS*

**POLYPROPYLENE**
**Combustion Products**
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)

**POLYSACCHARIDES**
*See also CELLULOSE*
*HEMICELLULOSE*
*LIGNIN*
*NITROCELLULOSE*
**Biological Functions**
Genetics and biochemistry of the Rhizobium meliloti acidic extracellular heteropolysaccharide and its role in nodulation: Annual report for the period 1 June 1986-31 May 1987, 12:36626 (R;US)
**Biosynthesis**
Common loci for Agrobacterium tumefaciens and Rhizobium meliloti exopolysaccharide synthesis and their roles in plant interactions, 12:37865 (J;US)
**Liquid Column Chromatography**
Genetics and biochemistry of the Rhizobium meliloti acidic extracellular heteropolysaccharide and its role in nodulation: Annual report for the period 1 June 1986-31 May 1987, 12:36626 (R;US)

**POLYTETRAFLUOROETHYLENE**
*See also TEFLON*
**Tribology**
Investigation of PTFE transfer films by infrared emission spectroscopy and phase-locked ellipsometry, 12:37344 (R;US)

**POLYTHENE**
*See POLYETHYLENES*

**POLYTHIONATES**
*See OXYGEN COMPOUNDS*
*SULFUR COMPOUNDS*

**POLYTHIONIC ACIDS**
*See OXYGEN COMPOUNDS*
*SULFUR COMPOUNDS*

**POOL BOILING**
**Bubble Growth**
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
**Heat Transfer**
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)

**POPLARS**
**Plant Growth**
Biological inference from growth-climate correlations in balsam poplar in Alaska, 12:37742 (RA;US)

**POPULATION DYNAMICS**
**Meetings**
Mechanisms of compensatory response of fish populations: Workshop proceedings, 12:36617 (R;US)

**PORE STRUCTURE**
*See MICROSTRUCTURE*

**POROUS MATERIALS**
**Drainage**
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:37822 (R;US)
**Fluid Flow**
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:37822 (R;US)
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions, 12:36384 (R;US)

**PORPHYRINS**
*See also CHLOROPHYLL*
**Catalytic Effects**
The testing of catalysts for alkane activation, 12:36600 (R;US)

**PORPOISES**
*See CETACEANS*

**PORTSMOUTH GASEOUS DIFFUSION PLANT**
**Hazardous Materials**
Mortality among uranium enrichment workers, 12:36480 (R;US)
**Personnel**
Mortality among uranium enrichment workers, 12:36480 (R;US)
**PORTSMOUTH PLANT**
*See PORTSMOUTH GASEOUS DIFFUSION PLANT*
**POSITIVE COLUMN**
**Oxygen Ions**
Radial density distribution of negative atomic oxygen in the oxygen positive column: an experiment. Master's thesis, 12:38100 (R;US)
**POSITRON COMPUTED TOMOGRAPHY**
**Historical Aspects**
An introduction to the physics and instrumentation of positron emission tomography, 12:37874 (R;US)
**Image Processing**
An introduction to the physics and instrumentation of positron emission tomography, 12:37874 (R;US)
**Performance**
Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics, 12:37573 (J;NL)
**POSITRON DETECTION**
**Design**
An introduction to the physics and instrumentation of positron emission tomography, 12:37874 (R;US)
**POSTULATED PARTICLES**
*See also HEAVY LEPTONS*
*HIGGS BOSONS*
*MAGNETIC MONOPOLES*
*QUARKS*
*TOP PARTICLES*
**Particle Production**
New stable charged particles, 12:38181 (RA;US)
Physics from PEP, 12:38134 (RA;US)
Recent results from the UA1 experiment at CERN, 12:38131 (RA;US)
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
Supersymmetric particle searches, 12:38177 (RA;US)
**POTASSIUM**
**Chemical Analysis**
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
**Heat Pipes**
Performance correlations for high temperature potassium heat pipes, 12:36803 (R;US)
**POTASSIUM ALLOYS**
**Structure Factors**
Structure of liquid equiatomic potassium—lead alloy: A neutron diffraction experiment, 12:37246 (J;US)
**POTASSIUM CARBONATES**
**Thermodynamic Properties**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**POTASSIUM CHLORIDES**
**Thermodynamic Properties**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**POTASSIUM COMPOUNDS**
*See also POTASSIUM CARBONATES*
*POTASSIUM CHLORIDES*
*POTASSIUM SULFATES*
**Plasma Waves**
X-ray diffraction study of the metastable charge-density-wave state of K/sub 0.3/$MoO_3$, 12:37355 (J;US)
**X-Ray Diffraction**
X-ray diffraction study of the metastable charge-density-wave state of K/sub 0.3/$MoO_3$, 12:37355 (J;US)
**POTASSIUM SULFATES**
**Thermochemical Diagrams**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
**POWDERS**
**Heat Transfer**
Nusselt number correlations for heat transfer to small spheres in thermal plasma flows, 12:37445 (J;US)
**Nondestructive Testing**
Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)
**Nusselt Number**
Nusselt number correlations for heat transfer to small spheres in thermal plasma flows, 12:37445 (J;US)
**POWER GENERATION**
*See also COGENERATION*
Electrical behavior of wind power stations: Final report, 12:36646 (R;US)
**Data Compilation**
Monthly energy review, March 1987, 12:36977 (R;US)
**POWER PLANTS**
*See also FUEL CELL POWER PLANTS*
*HYDROELECTRIC POWER PLANTS*
*THERMAL POWER PLANTS*
*TIDAL POWER PLANTS*
*WIND POWER PLANTS*
**Statistical Data**
Power plant report, monthly cumulative for 1987 (EIA-759). Data file, 12:36999 (R;US)
**POWER POOLS**
*See INTERCONNECTED POWER SYSTEMS*
**POWER REACTORS**
*See also BEAVER VALLEY-2 REACTOR*
*BROWNS FERRY-1 REACTOR*
*CHERNOBYLSK-4 REACTOR*
*CRYSTAL RIVER-3 REACTOR*
*EBR-2 REACTOR*
*HATCH-2 REACTOR*
*HOPE CREEK-2 REACTOR*
*LAGUNA VERDE-1 REACTOR*
*LAGUNA VERDE-2 REACTOR*
*N-REACTOR*
*PFR REACTOR*
*SEQUOYAH-1 REACTOR*
*SEQUOYAH-2 REACTOR*
*SPACE POWER REACTORS*
*SURRY-1 REACTOR*
*SURRY-2 REACTOR*
*SURRY-3 REACTOR*
*SURRY-4 REACTOR*
*THREE MILE ISLAND-2 REACTOR*
*ZION-1 REACTOR*
*ZION-2 REACTOR*
**Fuel Cycle**
Consolidated Fuel Reprocessing Program: Progress report for period October 1 to December 31, 1986, 12:36488 (R;US)
**In Core Instruments**
Neutron spectrum adjustment with SANDII using arbitrary trial functions, 12:36800 (R;US)
**Neutron Flux**
Neutron spectrum adjustment with SANDII using arbitrary trial functions, 12:36800 (R;US)
**POWER SUPPLIES**
*See also PHOTOVOLTAIC POWER SUPPLIES*
*SPACECRAFT POWER SUPPLIES*
**Manufacturing**
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)
**Time-of-Use Pricing**
Switching-off power loads in industry, 12:36998 (R;DK;In Danish)
**POWER SYSTEMS**
*Includes electric power networks with associated generating and transmission facilities.*
*See also INTERCONNECTED POWER SYSTEMS*
**Dielectric Properties**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Electromagnetic Pulses**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)

**Failure Mode Analysis**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**Surges**
Impact of steep front, short duration impulses on power system apparatus and insulation: A critical review, 12:36771 (BA;US)
**POWER TRANSMISSION**
**Control Systems**
Impact of adaptive protection on power system control, 12:36769 (R;US)
**Network Analysis**
Composite generation-transmission expansion planning: Final report, 12:36770 (R;US)
**POWER TRANSMISSION LINES**
**Relays**
Adaptive transmission relaying concepts for improved performance, 12:36767 (R;US)
**PRECIPITATION SCAVENGING**
**Calculation Methods**
Wet scavenging processes, 12:37704 (R;US)
**PRECIPITATIONS (ATMOSPHERIC)**
*See ATMOSPHERIC PRECIPITATIONS*
**PRECURSORS (DELAYED NEUTRON)**
*See DELAYED NEUTRON PRECURSORS*
**PRECURSORS (DELAYED NEUTRONS)**
*See DELAYED NEUTRON PRECURSORS*
**PREDICTION**
*See FORECASTING*
**PREFABRICATED BUILDINGS**
**Building Codes**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report], 12:37065 (R;US)
**Construction**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
**Energy Efficiency**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper: [Final report], 12:37063 (R;US)
**Energy Efficiency Standards**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report], 12:37065 (R;US)
**Fabrication**
Japan's manufactured housing capability: a review of the industry and assessment of future impact on the US market, 12:37055 (RA;US)
**Technology Transfer**
Japan's manufactured housing capability: a review of the industry and assessment of future impact on the US market, 12:37055 (RA;US)
**PRESSURE REGULATORS**
**Design**
Coal slurry letdown device, 12:36245 (RA;US)
Fluid friction control valve, 12:36248 (RA;US)
**Performance Testing**
Coal slurry letdown device, 12:36245 (RA;US)
Fluid friction control valve, 12:36248 (RA;US)
**Safety**
Pressure safety training for a large research and development facility, 12:38017 (R;US)
**PRESSURE VESSELS**
**Design**
Reduced girth seam weldments for heavy-walled vessels, 12:36249 (RA;US)
**Safety**
Pressure safety training for a large research and development facility, 12:38017 (R;US)
**Stresses**
Reduced girth seam weldments for heavy-walled vessels and burst tubes, 12:37456 (RA;US)
**Thickness**
Reduced girth seam weldments for heavy-walled vessels and burst tubes, 12:37456 (RA;US)
**PRESSURIZED WATER COOLED MODERATED REACTO**
*See PWR TYPE REACTORS*
**PRESSURIZED WATER REACTORS**
*See PWR TYPE REACTORS*
**PRICES**
*Prior to June 1979, CHARGES was used.*
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**PRIMARY COOLANT CIRCUITS**
**Decontamination**
System for removing contaminated surface layers, 12:36807 (TG;US)
**Flow Models**
Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels, 12:36933 (BA;US)
**Heat Transfer**
UPTF test results--first three separate effects tests, 12:36862 (RA;US)
**Hydraulics**
UPTF test results--first three separate effects tests, 12:36862 (RA;US)
**Hydrodynamics**
Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels, 12:36933 (BA;US)
**Pumps**
Physical model for reactor coolant pumps, 12:36871 (RA;US)
**Surface Contamination**
System for removing contaminated surface layers, 12:36807 (TG;US)
**Transients**
Experimental and analytical study of loss-of-flow transients in EBR-II occurring at decay power levels, 12:36933 (BA;US)
**PRINTING AND PUBLISHING INDUSTRY**
**Hazardous Materials**
Health-hazard evaluation report HETA 86-348-1756, J'Leen Ltd., Boulder, Colorado, 12:37703 (R;US)
**PROBES**
*See also ION PROBES*
**Radiowave Radiation**
New investigation method for the calculation of energy content of peatland by means of a radio wave probe, 12:36338 (R;SE;In Swedish)
**PROCESSING (WASTES)**
*See WASTE PROCESSING*
**PRODUCTION CAPACITY**
*See CAPACITY*
**PRODUCTION (HYDROGEN)**
*See HYDROGEN PRODUCTION*
**PRODUCTION (PAIR)**
*See PAIR PRODUCTION*
**PRODUCTIVITY**
**Monitoring**
What does the customer expect from inventories of endangered forests, 12:37895 (RA;DE;In German)
**PROJECT (CROSSROADS)**
*See CROSSROADS PROJECT*
**PROJECT (GREENHOUSE)**
*See GREENHOUSE PROJECT*
**PROJECTILES**
**Dynamics**
Performance analysis of the two-stage light gas gun, 12:37468 (R;US)

**PROMETHIUM IONS**
**Stimulated Emission**
Promethium ($Pm^{3+}$) solid state laser, 12:37474 (R;US)
**PROMINENCES (SOLAR)**
*See SOLAR PROMINENCES*
**PRONGS**
*See PARTICLE TRACKS*
**PROPAGATION (WAVE)**
*See WAVE PROPAGATION*
**1-PROPANOL**
*See PROPANOLS*
**2-PROPANOL**
*See PROPANOLS*
**PROPANOLS**
**Decomposition**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**PROPPING AGENTS**
**Performance**
Long-term performance of proppants under simulated reservoir conditions, 12:36400 (BA;US)
**Rock-Fluid Interactions**
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**PROPULSION SYSTEMS**
**Acceleration**
Low-thrust rocket trajectories, 12:36821 (R;US)
**Mathematical Models**
Low-thrust rocket trajectories, 12:36821 (R;US)
**PROPYL ALCOHOLS**
*See PROPANOLS*
**PROTECTION**
*See SAFETY*
**PROTECTION (RADIATION)**
*See RADIATION PROTECTION*
**PROTECTIVE CLOTHING**
**Design**
Protective clothing use at the Savannah River Plant Nuclear Facility, 12:37457 (R;US)
**Manuals**
Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
**Uses**
Protective clothing use at the Savannah River Plant Nuclear Facility, 12:37457 (R;US)
**PROTEINS**
*See also CALMODULIN*
*RHODOPSIN*
**Radioimmunoassay**
Calmodulin and calmodulin binding proteins in amphibian rod outer segments, 12:37879 (J;US)
**Radioreceptor Assay**
Epidermal growth factor-nonresponsive 3T3 variants do not contain epidermal growth factor receptor-related antigens or mRNA, 12:37880 (J;US)
**PROTON BEAMS**
**Beam Luminosity**
Luminosity of continuous beams with crossing angle, 12:37546 (BA;US)
**PROTON REACTIONS**
**Charge-Exchange Reactions**
(p-arrow-right,n) reaction on carbon isotopes at E/sub p/ = 160 MeV, 12:38241 (J;US)
**Inclusive Interactions**
Measurement of the ratio of $\Sigma^0$ to $\Lambda^0$ inclusive production from 28.5-GeV/c protons on beryllium, 12:38151 (J;US)
**Particle Production**
Recent axion searches, 12:38142 (RA;US)
**Research Programs**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)
**PROTON-ANTIPROTON INTERACTIONS**
**Particle Production**
Recent results from the UA1 experiment at CERN, 12:38131 (RA;US)
**Research Programs**
1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components, 12:37538 (BA;US)
**PROTON-NEUTRON INTERACTIONS**
**Isospin**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Particle Production**
Search for short-lived axions emitted from neutron capture on protons, 12:38153 (BA;DE)
**Polarized Beams**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**Polarized Targets**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
**PROTON-PROTON INTERACTIONS**
**Inelastic Scattering**
Branching, geometrical scaling, and Koba-Nielsen-Olesen scaling, 12:38200 (J;US)
**Multiple Production**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**Particle Production**
Charm hadroproduction in pp interactions at 400 GeV/c and 800 GeV/c, 12:38141 (RA;US)
Latest results from the UA2 experiment, 12:38132 (RA;US)
Search for gluonic bound states in high energy proton-proton collisions, 12:38154 (D;US)
**Research Programs**
1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components, 12:37538 (BA;US)
**Scaling Laws**
Branching, geometrical scaling, and Koba-Nielsen-Olesen scaling, 12:38200 (J;US)
**PROTOTYPE FAST REACTOR DOUNREAY**
*See PFR REACTOR*
**PSEUDOMONAS**
**Sensitivity**
Self-protection of Pseudomonas syringae pv. tabaci from its toxin, tabtoxinine-$\beta$-lactam, 12:37881 (J;US)
**PSI-3105 RESONANCES**
**Hadronic Particle Decay**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
**Particle Production**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
**Radiative Decay**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
**PTFE**
*See POLYTETRAFLUOROETHYLENE*
**PUBLIC BUILDINGS**
**Energy Conservation**
Analyzing energy conservation retrofits in public housing: savings, cost-effectiveness, and policy implications, 12:37040 (RA;US)
**PUBLIC HEALTH**
Guidelines for the selection of chemical-protective clothing. Volume 2. Technical and reference manual. (3rd Edition). Report for January 1985-March 1987, 12:37449 (R;US)
Guidelines for the selection of chemical-protective clothing. Volume 1. (3rd Edition). Report for January 1985-May 1987, 12:37451 (R;US)
Health-hazard evaluation report HETA 85-309-1739, Oregon Department of Human Resources, Health Division, Gypsy Moth Control Project, Eugene, Oregon, 12:37631 (R;US)
Superfund public health evaluation manual, 12:37892 (R;US)
**Health Hazards**
Preliminary evaluations of initial TSCA (Toxic Substances Control Act) Section 8(e) substantial risk notices. January 1, 1985 to December 31, 1986, 12:37891 (R;US)

**Risk Assessment**
Risk assessment, management, communication: a guide to selected sources. Information guide, 12:36966 (R;US)

**PUBLIC UTILITIES**
*See also ELECTRIC UTILITIES*
**Cost Estimation**
Documentation and user's manual for the Utility Cost Analysis Model. Final report, 12:36953 (R;US)
**Investment**
Documentation and user's manual for the Utility Cost Analysis Model. Final report, 12:36953 (R;US)
**Marketing Research**
Proceedings: 1986 Electric Utility Market Research symposium, 12:36995 (R;US)

**PULMONARY CANCER**
*See CARCINOMAS*

**PULMONARY LAVAGE**
*See LUNGS*

**PULSE COMBUSTORS**
**Chemical Reaction Kinetics**
Response of a pulse combustor to changes in total ignition delay time, 12:37523 (R;US)
**Combustion Kinetics**
Response of a pulse combustor to changes in total ignition delay time, 12:37523 (R;US)
**Flow Models**
Response of a pulse combustor to changes in total ignition delay time, 12:37523 (R;US)

**PULVERIZED FUEL ASH**
*See FLY ASH*

**PUMPS**
*See also WATER PUMPS*
**Electrodes**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)
**Electrolytes**
Materials development for solid oxide oxygen production unit, 12:37293 (R;US)

**PUREX PROCESS**
**High-Level Radioactive Wastes**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
**Off-Gas Systems**
Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)

**PWR TYPE REACTORS**
*See also BEAVER VALLEY-2 REACTOR*
*BW STANDARD REACTOR*
*CRYSTAL RIVER-3 REACTOR*
*SEQUOYAH-1 REACTOR*
*SEQUOYAH-2 REACTOR*
*SURRY-1 REACTOR*
*SURRY-2 REACTOR*
*SURRY-3 REACTOR*
*SURRY-4 REACTOR*
*THREE MILE ISLAND-2 REACTOR*
*WESTINGHOUSE STANDARD REACTOR*
*ZION-1 REACTOR*
*ZION-2 REACTOR*
**Containment Systems**
Containment and piping research, 12:36890 (RA;US)
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
Recent experimental and analytical results of BNL direct containment heating programs, 12:36911 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
**ECCS**
Experience with the revised Appendix K, 12:36839 (RA;US)
Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
Revision of the ECCS rule, 12:36837 (RA;US)
**Heat Transfer**
Some preliminary results of post-dryout heat transfer measurements at low qualities and pressures up to 20 bar, 12:36883 (RA;US)
**High Pressure Coolant Injection**
Scaling of thermal mixing phenomena from one-fifth to full scale test facilities, 12:36857 (RA;US)
Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs, 12:36856 (RA;US)
**Ice Condensers**
Ice condenser testing facility and plans, 12:36904 (RA;US)
**Lifetime**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
**Loss of Coolant**
Analysis results from the Los Alamos 2D/3D program, 12:36863 (RA;US)
Comparison of a TRAC calculation to the data from LSTF run SB-CL-05, 12:36849 (RA;US)
Development of reflood model at JAERI, 12:36861 (RA;US)
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
Heat transfer enhancement in SCTF tests, 12:36860 (RA;US)
Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
PWR recovery procedures investigated in the LOBI-MOD2 test facility, 12:36842 (RA;US)
SCTF-III test plan and recent SCTF-III test result, 12:36859 (RA;US)
Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
Summary of CCTF test results, 12:36858 (RA;US)
Two-phase flow measurement in the upper plenum of a PWR during reflood, 12:36851 (RA;US)
**Meltdown**
Possibilities of hydrogen removal phase III: Selected countermeasures of hydrogen mitigation for hypothetical accidents in a pressurized water reactor, 12:36822 (R;DE;In German)
**Mixed Oxide Fuels**
Safeguards implications related to the use of mixed oxide fuel assemblies in light water reactors, 12:36571 (R;US)
**Nuclear Data Collections**
Nuclear plant data bank, 12:36870 (RA;US)
**Outages**
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**Pipes**
Containment and piping research, 12:36890 (RA;US)
Pipe-to-pipe impact program, 12:36778 (R;US)
**Primary Coolant Circuits**
Physical model for reactor coolant pumps, 12:36871 (RA;US)
UPTF test results--first three separate effects tests, 12:36862 (RA;US)
**Reactor Accidents**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
Influence of moisture on the behavior of aerosols, 12:36898 (RA;US)
LWR aerosol containment experiments (LACE) program summary and preliminary observations, 12:36899 (RA;US)
MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
QUASAR uncertainty study, 12:36905 (RA;US)
RCS natural circulation in a PWR station blackout accident--an application of NRC mechanistic codes, 12:36906 (RA;US)
Recent results in hydrogen research, 12:36915 (RA;US)

Results from DEMONA aerosol experiments, 12:36902 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)
Thermal-hydraulic studies on molten core-concrete interactions, 12:36903 (RA;US)

**Reactor Components**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Reactor Control Systems**
Critical components and monitoring techniques for Nuclear Power Plant life extension, 12:36930 (R;US)

**Reactor Cooling Systems**
RCS natural circulation in a PWR station blackout accident--an application of NRC mechanistic codes, 12:36906 (RA;US)

**Reactor Core Disruption**
Precursors to potential severe core damage accidents: 1984 a status report: Main report and Appendixes A and B, 12:36921 (R;US)
Recent experimental and analytical results of BNL direct containment heating programs, 12:36911 (RA;US)
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)

**Reactor Instrumentation**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)

**Reactor Operation**
Licensee event report (LER) compilation: For month of April 1987, 12:36797 (R;US)
Licensee event report (LER) compilation for month of February 1987, 12:36796 (R;US)
Licensee event report (LER) compilation for month of January 1987, 12:36795 (R;US)
Use of probabilistic systems analysis for enhancing plant operational safety and productivity, 12:36891 (RA;US)

**Reactor Operators**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)

**Reactor Safety**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
Application of engineering and multi-dimensional, finite difference codes to HDR thermal mixing experiments, 12:36888 (RA;US)
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
Code uncertainty quantification, 12:36879 (RA;US)
Cold leg condensation in a large break LOCA using TRAC-PF1/MOD1, 12:36882 (RA;US)
Comparison of a TRAC calculation to the data from LSTF run SB-CL-05, 12:36849 (RA;US)
Containment and piping research, 12:36890 (RA;US)
CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
Development of reflood model at JAERI, 12:36861 (RA;US)
Dryout front modeling for rod bundles, 12:36852 (RA;US)
Experience with the revised Appendix K, 12:36839 (RA;US)
Experimental and best estimate code development on small break LOCA thermal-hydraulics and hydrogen mixing within subcompartmental containment vessel, 12:36917 (RA;US)
Finnish assessment of RELAP5/MOD2, 12:36875 (RA;US)
Heat transfer enhancement in SCTF tests, 12:36860 (RA;US)
Ice condenser testing facility and plans, 12:36904 (RA;US)
JRC ISPRA experience with the IBM version of RELAP5/MOD2, 12:36884 (RA;US)
Large model tests for containment performance and separate effects tests for penetrations, 12:36916 (RA;US)
Multidimensional representation of German pressurized water reactor primary system in 200% break LOCA calculation, 12:36864 (RA;US)
Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
Nuclear plant data bank, 12:36870 (RA;US)
Nuclear safety—forward on technology and backward on perception, 12:36889 (RA;US)
Physical model for reactor coolant pumps, 12:36871 (RA;US)
PKL III small breaks and transients experimental program, 12:36843 (RA;US)
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
PWR recovery procedures investigated in the LOBI-MOD2 test facility, 12:36842 (RA;US)
Recent experimental and analytical results of BNL direct containment heating programs, 12:36911 (RA;US)
Regulatory guide in support of ECCS rule revision, 12:36838 (RA;US)
RELAP5/MOD2 development, 12:36866 (RA;US)
Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG, 12:36872 (RA;US)
Revision of the ECCS rule, 12:36837 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
Scaling of thermal mixing phenomena from one-fifth to full scale test facilities, 12:36857 (RA;US)
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)
SCTF-III test plan and recent SCTF-III test result, 12:36859 (RA;US)
Semiscale recovery investigations: a comparison of results from Semiscale Mod-2C small break LOCA without HPI tests, 12:36847 (RA;US)
Simulation experiments for hot-leg u-bend two-phase flow phenomena, 12:36855 (RA;US)
Some preliminary results of post-dryout heat transfer measurements at low qualities and pressures up to 20 bar, 12:36883 (RA;US)
Status of integral facilities and future plans for integral testing, 12:36840 (RA;US)
Status of J-TRAC code development, 12:36887 (RA;US)
STCP validation, 12:36909 (RA;US)
Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)
Summary of CCTF test results, 12:36858 (RA;US)
Swedish experience with RELAP5/MOD2 assessment, 12:36874 (RA;US)
Tests of the TRAC code against known analytical solutions for stratified flow, 12:36881 (RA;US)
Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs, 12:36856 (RA;US)
TRAC code development status and plans, 12:36867 (RA;US)
Two-phase flow measurement in the upper plenum of a PWR during reflood, 12:36851 (RA;US)
UPTF test results--first three separate effects tests, 12:36862 (RA;US)
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Reactor Shutdown**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)

**Reliability**
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**RHR Systems**
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)

**Risk Assessment**
Use of probabilistic systems analysis for enhancing plant operational safety and productivity, 12:36891 (RA;US)

**Rod Bundles**
Dryout front modeling for rod bundles, 12:36852 (RA;US)

**Service Life**
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)

**Source Terms**
STCP validation, 12:36909 (RA;US)

**Steam Separators**
Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)

**Systems Analysis**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**Temperature Measurement**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Transients**
Application of engineering and multi-dimensional, finite difference codes to HDR thermal mixing experiments, 12:36888 (RA;US)
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
Code uncertainty quantification, 12:36879 (RA;US)
Cold leg condensation in a large break LOCA using TRAC-PF1/MOD1, 12:36882 (RA;US)
CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
Finnish assessment of RELAP5/MOD2, 12:36875 (RA;US)
JRC ISPRA experience with the IBM version of RELAP5/MOD2, 12:36884 (RA;US)
Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG, 12:36872 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
Status of J-TRAC code development, 12:36887 (RA;US)
Tests of the TRAC code against known analytical solutions for stratified flow, 12:36881 (RA;US)

**PWR**
**241 TYPE REACTORS**
*See BW STANDARD REACTOR*
**41 TYPE REACTORS**
*See WESTINGHOUSE STANDARD REACTOR*

**PYRENE**
**Liquid Column Chromatography**
Pulsed-laser photothermal refraction detection in capillary liquid chromatography, 12:37385 (J;US)

**PYRIDINE**
**Adsorption**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)

**PYRIDINES**
*See also BIPYRIDINES*
*PYRIDINE*
*QUINOLINES*
**Gas Chromatography**
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)

**PYRITE**
**Oxidation**
Surface chemical problems in coal flotation, 12:36234 (R;US)
**Particle Size**
An automated microscopic method for the determination of pyrite size distributions in crushed coal, 12:36298 (R;US)

**PYRITES**
*See PYRITE*

**PYROLYSIS**
*See also CRACKING*
**Chemical Reaction Kinetics**
Modelling of chamber coking as a reaction determined by heat transport, 12:36274 (R;DE;In German)
**Chemical Reactions**
Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms, 12:36296 (R;US)
**Forecasting**
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**Research Programs**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
**Technology Assessment**
Pyrolysis of municipal solid waste, 12:37154 (R;US)

**PYROLYSIS PRODUCTS**
*See also CHARS*
*PYROLYTIC GASES*
*PYROLYTIC OILS*
**Waste Product Utilization**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)

**PYROLYTIC GASES**
**Waste Product Utilization**
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)

**PYROLYTIC OILS**
**Waste Product Utilization**
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)

**PYROXYLIN**
*See NITROCELLULOSE*

**PYRROLES**
**Catalytic Effects**
Nickel site of methane catalysis in the methyl reductase enzyme, 12:36593 (R;US)

**PZT**
**Chemical Preparation**
Precipitation of PZT and PLZT powders using a continuous reactor, 12:37314 (BA;US)
**Precipitation**
Precipitation of PZT and PLZT powders using a continuous reactor, 12:37314 (BA;US)

## Q

**Q CODES**
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)

**QUANTUM CHROMODYNAMICS**
**Computerized Simulation**
Research program in computational physics: [Progress report for Task D], 12:38159 (R;US)
**Electroproduction**
Testing quantum chromodynamics in electroproduction, 12:38197 (R;US)
**Lattice Field Theory**
How to measure $\epsilon'/\epsilon$ with lattice QCD, 12:38224 (R;US)
**Lectures**
Experimental tests of quantum chromodynamics, 12:38146 (R;US)
**Perturbation Theory**
Perturbative QCD: K-factors, 12:38220 (RA;US)
**Reviews**
Experimental tests of quantum chromodynamics, 12:38221 (RA;US)
Perturbative QCD: K-factors, 12:38220 (RA;US)
**Soft-Core Potential**
Nonperturbative extension of the light-front QCD, 12:38267 (R;US)
**Testing**
Experimental tests of quantum chromodynamics, 12:38221 (RA;US)
Phenomenology of heavy quark systems, 12:38129 (RA;US)
**Validation**
Experimental tests of quantum chromodynamics, 12:38146 (R;US)

**QUANTUM ELECTRODYNAMICS**
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)

**QUANTUM ELECTRONICS**
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems, 12:38219 (R;IT)
**QUANTUM FIELD THEORY**
*See also LATTICE FIELD THEORY*
*QUANTUM CHROMODYNAMICS*
*QUANTUM ELECTRODYNAMICS*
**Symmetry Breaking**
Broken symmetry and the accelerated observer, 12:38226 (BA;US)
**QUANTUM MECHANICS**
On the discrete reconciliation of relativity and quantum mechanics, 12:38310 (R;US)
**Measure Theory**
Measurement by phase severance, 12:38309 (R;US)
**Wave Packets**
The group velocity of short optical pulses, 12:38318 (BA;US)
**QUARK MODEL**
*See also STRING MODELS*
**Cluster Model**
[Intermediate/high energy probes and the structure of nuclei]: Final report, 12:38270 (R;US)
**Degrees of Freedom**
Short range phenomena, 12:38161 (R;US)
**Relativistic Range**
Short range phenomena, 12:38161 (R;US)
**Research Programs**
[Intermediate/high energy probes and the structure of nuclei]: Final report, 12:38270 (R;US)
**QUARK-ANTIQUARK INTERACTIONS**
**Potentials**
Monte Carlo determination of the spin-dependent potentials, 12:38155 (R;US)
**QUARKONIUM**
*A hypothetical bound state of quark and antiquark.*
**Mass Spectra**
Phenomenology of heavy quark systems, 12:38129 (RA;US)
**Semileptonic Decay**
Phenomenology of heavy quark systems, 12:38129 (RA;US)
**Weak Hadronic Decay**
Phenomenology of heavy quark systems, 12:38129 (RA;US)
**QUARKS**
**Composite Models**
Compositeness below 1 TeV, 12:38194 (RA;US)
**CP Invariance**
Status of electroweak theory for heavy quark decays and CP violation, 12:38209 (BA;DE)
**Flavor Model**
Indirect searches for ultra-heavy quarks in rare decays, 12:38204 (J;NL)
**Particle Production**
New stable charged particles, 12:38181 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Rest Mass**
Fate of the m/sub b//m/sub tau/ mass relation in superstring theories, 12:38202 (J;NL)
Indirect searches for ultra-heavy quarks in rare decays, 12:38204 (J;NL)
**QUARTZ**
**Physical Radiation Effects**
The effect of radiation on twinning in quartz, 12:37361 (J;US)
**Twinning**
The effect of radiation on twinning in quartz, 12:37361 (J;US)
**QUATERNARY PERIOD**
**Erosion**
Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)
**QUEBEC**
**Archaeological Sites**
Tree-ring reconstruction of Indian-Cree tree harvesting in the area, Quebec, Poste-de-la-Baleine, 12:38029 (RA;US)
**Paleoclimatology**
Dating landslides in Hudson Bay area, Quebec, 12:38023 (RA;US)
**QUERCUS**
*See OAKS*
**QUINOLINES**
**Hydrometallurgy**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Solubility**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)
**Solvent Extraction**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**QUINONES**
**Photochemical Reactions**
Photoinduced electron transfer in fixed distance chlorophyll-quinone donor-acceptor molecules, 12:36622 (R;US)

## R

**R CODES**
Documentation of the resource allocation and mine costing (RAMC) model: Methodology description, 12:36984 (R;US)
Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual, 12:37834 (R;US)
Pulsed zero field NMR of solids and liquid crystals, 12:38299 (R;US)
**RACIAL GROUPS**
*See MINORITY GROUPS*
**RADAR**
**Data Analysis**
Experiment in knowledge-based signal understanding using parallel architectures. Technical report, 12:38404 (R;US)
**Incoherent Scattering**
Comparison of ionospheric-model predictions with MITHRAS observations. Scientific report (Final), 14 November 1983-14 November 1986, 12:38086 (R;US)
**RADIATION ABSORPTION ANALYSIS**
**Radiometric Gages**
Two-channel gamma-ray method applied to three-component analyses in hydraulic transport systems, 12:37563 (R;DE)
**RADIATION ACCIDENTS**
**Data Compilation**
Report to the US Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data, 1986, 12:36836 (R;US)
**RADIATION BURDEN**
*See RADIATION DOSES*
**RADIATION CHEMISTRY**
**Research Programs**
Magnetic resonance and optical spectroscopic studies of radiation produced radicals: Progress report, December 1, 1986-November 30, 1987, 12:37435 (R;US)
Pulse radiolytic studies of inter- and intramolecular electron transfer processes: Progress report, 12:37434 (R;US)
**RADIATION DETECTION AND RANGE**
*See RADAR*
**RADIATION DETECTORS**
*See also IONIZATION CHAMBERS*
*SHOWER COUNTERS*
**Comparative Evaluations**
A primer on detectors in high luminosity environment, 12:37574 (BA;US)
**Performance**
Space radiation studies. Annual report, November 1985-November 1986, 12:37567 (R;US)
**Reviews**
A primer on detectors in high luminosity environment, 12:37574 (BA;US)

**Specifications**
Space radiation studies. Annual report, November 1985-November 1986, 12:37567 (R;US)
**Validation**
Validation of the abbreviated Radon Progeny Integrating Sampling Unit (RPISU) method for Mesa County, Colorado, 12:37820 (R;US)

**RADIATION DOSE DISTRIBUTIONS**
**Computerized Simulation**
Computer fallout code using variable winds for operational-type studies. Master's thesis, 12:37586 (R;US)

**RADIATION DOSES**
*See also LETHAL RADIATION DOSE*
**Calculation Methods**
New buildup factor data for point kernel calculations, 12:38291 (R;US)
**Computer Calculations**
GASPAR II: Technical reference and user guide, 12:37931 (R;US)
**G Codes**
GASPAR II: Technical reference and user guide, 12:37931 (R;US)
**Mathematical Models**
Notes on the effect of dose uncertainty, 12:37902 (R;US)
**Standards**
New buildup factor data for point kernel calculations, 12:38291 (R;US)

**RADIATION EXPOSURE (DOSES)**
*See RADIATION DOSES*

**RADIATION HAZARDS**
**Human Factors Engineering**
Air Force Technical Objectives Document, Fiscal Year 1988. Annual report, January 1986-January 1987, 12:37185 (R;US)

**RADIATION HYGIENE**
*See RADIATION PROTECTION*

**RADIATION MONITORS**
*See also NEUTRON MONITORS*
New portable hand-held radiation instruments for measurements and monitoring, 12:36561 (R;US)

**RADIATION PROTECTION**
**Meetings**
Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring, 12:36555 (R;US)
**Recommendations**
Microdosimetric basis for exposure limits, 12:37932 (R;US)

**RADIATION SAFETY**
*See RADIATION PROTECTION*

**RADIOACTIVE AEROSOLS**
**Monitoring**
Proceedings of the Department of Energy workshop on Workplace Aerosol Monitoring, 12:36555 (R;US)
**Scrubbers**
Design procedure for sizing a submerged-bed scrubber for airborne particulate removal, 12:37722 (R;US)

**RADIOACTIVE BIOLOGICAL WASTES**
*See RADIOACTIVE WASTES*

**RADIOACTIVE EFFLUENTS**
**Waste Management**
Environmental information document: Y Area, 12:36549 (R;US)

**RADIOACTIVE GASEOUS WASTES**
*See GASEOUS WASTES*
*RADIOACTIVE WASTES*

**RADIOACTIVE MATERIALS**
*See also RADIOACTIVE WASTES*
**Detection**
A neutron portal monitor for vehicles, 12:36562 (R;US)
**Environmental Exposure Pathway**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
**Materials Handling**
WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
**Neutron Monitors**
A neutron portal monitor for vehicles, 12:36562 (R;US)
**Packaging**
Base technology development enhances state-of-the-art in meeting performance requirements, 12:37465 (R;US)
**Remote Sensing**
WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
**Transport**
Base technology development enhances state-of-the-art in meeting performance requirements, 12:37465 (R;US)

**RADIOACTIVE PARTICULATES**
*See PARTICLES*
*RADIOACTIVE AEROSOLS*

**RADIOACTIVE TRACERS**
*See RADIOPHARMACEUTICALS*
*TRACER TECHNIQUES*

**RADIOACTIVE WASTE DISPOSAL**
**Containers**
Nuclear waste package fabricated from concrete, 12:36503 (R;US)
**Cost**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Education**
The need for public education: Nuclear waste disposal programs, 12:36545 (BA;US)
**Environmental Transport**
Low-level waste source term evaluation: Review of published modeling and experimental work, and presentation of low-level waste source term modeling framework and preliminary model development: Topical report, 12:36521 (R;US)
**Feasibility Studies**
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
**Fission Product Release**
Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
**Grouting**
Pilot-scale grout production test with a simulated low-level waste, 12:36527 (R;US)
**Inspection**
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Leaching**
Data report on static leach tests with Savannah River Laboratory defense waste glass in PBB1 brine at 90°C: Salt Repository Project, 12:36531 (R;US)
Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
**Monitoring**
Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste, 12:36510 (R;US)
**Planning**
Defense Waste Management Plan for buried transuranic-contaminated waste, transuranic-contaminated soil, and difficult-to-certify transuranic waste, 12:36506 (R;US)
Design of saltstone vaults, 12:36512 (R;US)
**Public Opinion**
The need for public education: Nuclear waste disposal programs, 12:36545 (BA;US)
**Radiation Protection**
Considerations on a de minimis dose and disposal of exempt concentrations of radioactive wastes, 12:36525 (R;US)
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Radionuclide Migration**
Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)
**Recommendations**
A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
**Reviews**
Spent fuel performance in geologic repository environments, 12:36530 (R;US)

**Risk Assessment**
A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Site Selection**
Area Recommendation Report for the Crystalline Repository Project: Volume 1, Draft, 12:36504 (R;US)
Area Recommendation Report for the Crystalline Repository Project: Volume 2, Plates: Draft (Maps; no text), 12:36505 (R;US)
Groundwater chemistry at Yucca Mountain, Nevada, and vicinity (NNWSI), 12:36519 (R;US)
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$, 12:36520 (R;US)
Nuclear waste package fabricated from concrete, 12:36503 (R;US)
Status of geologic investigations for nuclear waste disposal at the Nevada Test Site, 12:36509 (RA;US)
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984, 12:36536 (R;US)
**Underground Disposal**
Comparison of results for ten analytical heat conduction problems as solved by the general heat transfer code HEATING5 [Heat Engineering and Transfer in Nine Geometries], 12:36498 (R;US)
Geologic software for nuclear waste repository studies: A quality assurance program, 12:36529 (R;US)
Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel, 12:36534 (R;US)
**Water Pollution Monitors**
Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)

**RADIOACTIVE WASTE FACILITIES**
*See also WIPP*
**Design**
Design of saltstone vaults, 12:36512 (R;US)
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Operation**
Verification report for SIMREP 1.1, 12:36499 (R;US)
**S Codes**
Verification report for SIMREP 1.1, 12:36499 (R;US)
**Site Selection**
The socioeconomic impacts of high-level nuclear waste facility siting, 12:36544 (BA;US)
**Socio-Economic Factors**
The socioeconomic impacts of high-level nuclear waste facility siting, 12:36544 (BA;US)

**RADIOACTIVE WASTE MANAGEMENT**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)
**Environmental Policy**
Status of U.S. nuclear waste disposal programs, 12:36543 (BA;US)
**Legislation**
Status of U.S. nuclear waste disposal programs, 12:36543 (BA;US)

**RADIOACTIVE WASTE PROCESSING**
**Containment**
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
**Containment Buildings**
STS [supernatant treatment system] confinement barrier integrity review for the West Valley Demonstration Project, 12:36507 (R;US)
**Demonstration Programs**
Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)
**Hazards**
Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)
**Radioactive Waste Disposal**
Design of saltstone vaults, 12:36512 (R;US)
**Safety**
Technical and administrative approach for the West Valley Demonstration Project Safety Program, 12:36553 (R;US)

**RADIOACTIVE WASTE STORAGE**
Determination of background radiological characteristics within the Palo Duro Basin, Texas: Technical report, 12:37818 (R;US)
**Materials Handling**
WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
**Packaging**
Waste disposal package, 12:36542 (P;GB)
**Remote Sensing**
WATCH [Wireless Alarm Transmission of Container Handling]: A low-cost, secure-item monitoring system, 12:36569 (R;US)
**Underground Disposal**
Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:36539 (R;US)

**RADIOACTIVE WASTES**
*See also ALPHA-BEARING WASTES*
*HIGH-LEVEL RADIOACTIVE WASTES*
*LOW-LEVEL RADIOACTIVE WASTES*
*RADIOACTIVE EFFLUENTS*
**Classification**
A proposed classification system for high-level and other radioactive wastes, 12:36524 (R;US)
Waste-acceptance criteria for radioactive waste disposal, 12:36501 (R;US)
**Liquids**
Design of saltstone vaults, 12:36512 (R;US)
**Radiation Monitoring**
New portable hand-held radiation instruments for measurements and monitoring, 12:36561 (R;US)
**Reinjection**
Statistical structure and filter characteristics of tritium fluctuations in fractured basalt, 12:36541 (J;US)
**Sample Preparation**
Preparation of radioactive "mixed" waste samples for measurement of RCRA [Resource Conservation and Recovery Act] organic compounds (Mixed waste containing alpha-, beta-, or gamma-emitting radionuclides), 12:37371 (R;US)
**Solids**
Design of saltstone vaults, 12:36512 (R;US)

**RADIOACTIVITY TRANSPORT**
**T Codes**
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:37822 (R;US)

**RADIOCHEMICAL LABORATORIES**
*See HOT LABS*

**RADIOGRAPHY (BIOMEDICAL)**
*See BIOMEDICAL RADIOGRAPHY*

**RADIOGRAPHY (INDUSTRIAL)**
*See INDUSTRIAL RADIOGRAPHY*

**RADIOISOTOPE HEAT SOURCES**
**Uses**
Assessment of radioisotope heaters for remote terrestrial applications, 12:36574 (R;US)

**RADIOISOTOPE KINETICS**
*See RADIONUCLIDE KINETICS*

**RADIOISOTOPE MIGRATION**
*See RADIONUCLIDE MIGRATION*

**RADIOISOTOPE-LABELLED DRUGS**
*See RADIOPHARMACEUTICALS*

**RADIOISOTOPES**
*See also DELAYED NEUTRON PRECURSORS*
**Mass Spectroscopy**
Present and future prospects of accelerator mass spectrometry, 12:37370 (R;US)

**RADIOLOGICAL PROTECTION**
*See RADIATION PROTECTION*

**RADIOMETRIC SURVEYS**
**Automation**
A method to automate the radiological survey process, 12:37819 (R;US)
**RADIONUCLIDE DISTRIBUTIONS**
*See RADIONUCLIDE KINETICS*
**RADIONUCLIDE KINETICS**
*For radionuclides in living organisms only; see also TRANSLOCATION.*
Use of bioassay procedures for assessment of internal radionuclide deposition: Recommendations of the National Council on Radiation Protection and Measurements, 12:37877 (R;US)
**RADIONUCLIDE METABOLISM**
*See RADIONUCLIDE KINETICS*
**RADIONUCLIDE MIGRATION**
*In environment.*
**High-Level Radioactive Wastes**
Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36496 (R;US)
**Mathematical Models**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
Modeling study of solute transport in the unsaturated zone: Workshop proceedings, 12:37850 (R;US)
Subseabed Disposal Project annual report: Ocean modeling studies, October 1983 through September 1984 (From subseabed disposal in ocean), 12:36536 (R;US)
**T Codes**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
**RADIONUCLIDE TRANSFER (IN ENVIRONMENT)**
*See RADIONUCLIDE MIGRATION*
**RADIONUCLIDE TRANSFER (IN ORGANISMS)**
*See RADIONUCLIDE KINETICS*
**RADIONUCLIDE TURNOVER**
*See RADIONUCLIDE KINETICS*
**RADIONUCLIDES**
*See RADIOISOTOPES*
**RADIOPHARMACEUTICALS**
**Impurities**
Comparative investigations of different measurement methods of Radiochromatograms for the evaluation of the radiochemical purity of ten radiopharmaceuticals, 12:37438 (R;DE;In German)
Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis, 12:37439 (R;DE;In German)
**Qualitative Chemical Analysis**
Comparative investigations of different measurement methods of Radiochromatograms for the evaluation of the radiochemical purity of ten radiopharmaceuticals, 12:37438 (R;DE;In German)
Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis, 12:37439 (R;DE;In German)
**Stability**
Radiochemical purity and stability of I-131/I-125/I-123 o-iodohippuric acids. A market analysis, 12:37439 (R;DE;In German)
**RADIOPROTECTIVE SUBSTANCES**
*See also DTPA*
*GLUTATHIONE*
Evaluation of drugs for prevention of hyperthermia in rats exposed to microwave irradiation. Final report, 1983-1985, 12:38013 (R;US)
**RADIOSURGERY**
*See RADIOTHERAPY*
**RADIOTHERAPY**
**Research Programs**
Experimental tumour therapy. 1985 report. Report on the cooperation between the Institute of Radiation Biology of the University of Munich and the Institute for Radiation Biology of the Society for Radiation and Environmental Research, Neuherberg, 12:37903 (R;DE;In German)
**Synchrotrons**
Proton accelerator for medical applications, 12:37533 (J;NL)
**RADIUM**
**Environmental Exposure Pathway**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)
**RADIUM 226**
**Radioecological Concentration**
An improved method for the simultaneous determination of $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$ in water, soils and sediments, 12:37848 (R;US)
**RADIUM 228**
**Radioecological Concentration**
An improved method for the simultaneous determination of $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$ in water, soils and sediments, 12:37848 (R;US)
**RADIUM D**
*See LEAD 210*
**RADON**
**Air Pollution Control**
Monitoring before and after radon mitigation, 12:37719 (R;US)
Resolving the radon problem in Clinton, New Jersey houses. Published paper, April-December 1986, 12:37718 (R;US)
Some results from the demonstration of indoor radon reduction measures in block basement houses. Report for June 1985-February 1987, 12:37720 (R;US)
Statistical aspects of autoregressive models in the assessment of radon mitigation, 12:37717 (R;US)
**Air Pollution Monitoring**
Performance of continuous air monitors based on alpha spectroscopy in a dusty environment, 12:37714 (RA;US)
**Indoor Air Pollution**
Bibliography on indoor radon pollution, 12:37721 (R;US)
**Pollution Sources**
Radon source rate measurements using multiple perfluorocarbon tracers, 12:37709 (R;US)
**Radiation Monitors**
Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
**Radioecological Concentration**
Performance of continuous air monitors based on alpha spectroscopy in a dusty environment, 12:37714 (RA;US)
Radon source rate measurements using multiple perfluorocarbon tracers, 12:37709 (R;US)
The impacts of balanced and exhaust mechanical ventilation on indoor radon, 12:37712 (R;US)
Validation of the abbreviated Radon Progeny Integrating Sampling Unit (RPISU) method for Mesa County, Colorado, 12:37820 (R;US)
**Scintillation Counting**
Statistical aspects of autoregressive models in the assessment of radon mitigation, 12:37717 (R;US)
**RADON 220**
**Daughter Products**
Diffusivity study of free thoron decay products by deposition measurement on cylindrical tubes and screens, 12:37713 (RA;US)
**RAILGUN ACCELERATORS**
**Energy Efficiency**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)
**Magnetic Fields**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)
**RAMAN SPECTROSCOPY**
*Prior to March 1983 this concept was indexed to RAMAN SPECTRA.*
**Performance Testing**
Advanced coherent Raman diagnostics for coal gasification streams, 12:36304 (RA;US)
**RANGELANDS**
**Air Pollution**
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)

**RANKINE CYCLE ENGINES**
**Test Facilities**
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**Working Fluids**
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**RARE EARTHS**
*See also DYSPROSIUM*
**Abundance**
Trace rare earth element analysis in briny groundwaters, 12:38045 (R;US)
**Solvent Extraction**
Chelating extractants of improved selectivity: Final report, 12:37373 (R;US)
**RASCHIG RINGS**
*See COLUMN PACKING*
**RATS**
**Respiration**
Effect of continuous positive and negative pressure breathing on the respiratory pattern of conscious rats, 12:37885 (RA;US)
**RDF**
*See REFUSE DERIVED FUELS*
**REACTOR ACCIDENTS**
*See also LOSS OF COOLANT*
*MELTDOWN*
*REACTOR CORE DISRUPTION*
**Aerosols**
Influence of moisture on the behavior of aerosols, 12:36898 (RA;US)
Results from DEMONA aerosol experiments, 12:36902 (RA;US)
Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)
**C Codes**
Integrated ex-vessel source term analysis with the CONTAIN 1.1 computer code, 12:36901 (RA;US)
**Computer Codes**
Summary of aerosol code-comparison results for LWR aerosol containment tests LA1, LA2, and LA3, 12:36900 (RA;US)
**Containment Systems**
LWR aerosol containment experiments (LACE) program summary and preliminary observations, 12:36899 (RA;US)
**Data Base Management**
Update on standard problem, data base, and uncertainties, 12:36897 (RA;US)
**Data Compilation**
Report to the US Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data, 1986, 12:36836 (R;US)
**Emergency Plans**
NRC Incident Response Plan, 12:36833 (R;US)
**Environmental Effects**
Radioactivity in foods - Chernobyl and the consequences, 12:37817 (R;DE;In German)
**Explosions**
Steam explosion energetics, 12:36914 (RA;US)
**Fluid-Structure Interactions**
Proceedings of the Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris-concrete interactions, 12:36826 (R;US)
**Human Factors**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
**Hydrogen**
Recent results in hydrogen research, 12:36915 (RA;US)
**M Codes**
MELCOR validation and verification: 1986 papers, 12:36927 (R;US)
**Reactor Core Disruption**
Results from DEMONA aerosol experiments, 12:36902 (RA;US)
Steam explosion energetics, 12:36914 (RA;US)
Thermal-hydraulic studies on molten core-concrete interactions, 12:36903 (RA;US)
**Source Terms**
Integrated ex-vessel source term analysis with the CONTAIN 1.1 computer code, 12:36901 (RA;US)
QUASAR uncertainty study, 12:36905 (RA;US)
**System Failure Analysis**
Using operating experience and a cause coding tree to identify improvements for nuclear process control, 12:36825 (R;US)
**REACTOR COMPONENTS**
*See also FUEL ELEMENTS*
*REACTOR COOLING SYSTEMS*
*REACTOR CORES*
**Aging**
US Department of Energy Nuclear Plant Life Extension Program, 12:36929 (R;US)
**Fasteners**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Heat Pipes**
Performance correlations for high temperature potassium heat pipes, 12:36803 (R;US)
**Lifetime**
The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)
**Monitoring**
The identification and monitoring of critical components for nuclear life extension, 12:36806 (R;US)
**Restraints**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Welded Joints**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**REACTOR CONTROL SYSTEMS**
**Computerized Simulation**
Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
**Signals**
Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)
**REACTOR COOLING SYSTEMS**
*See also PRIMARY COOLANT CIRCUITS*
*RHR SYSTEMS*
**Natural Convection**
RCS natural circulation in a PWR station blackout accident--an application of NRC mechanistic codes, 12:36906 (RA;US)
**Repair**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**REACTOR CORE DISRUPTION**
**C Codes**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
**Computerized Simulation**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
**M Codes**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**R Codes**
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)
**S Codes**
SCDAP/RELAP5 update and applications, 12:36908 (RA;US)
**Simulation**
DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
**T Codes**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)

**REACTOR CORES**
*See also HETEROGENEOUS REACTOR CORES*
**Design**
Thermal-hydraulic considerations for particle bed reactors, 12:36781 (R;US)
**REACTOR DECOMMISSIONING**
**Cutting Tools**
Hot tests of the small portable arc saw using an electromechanical manipulator, 12:36935 (BA;US)
**REACTOR FUEL ELEMENTS**
*See FUEL ELEMENTS*
**REACTOR INSTRUMENTATION**
**Aging**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**Performance Testing**
Degradation of nuclear plant temperature sensors, 12:36774 (R;US)
**REACTOR MATERIALS**
*To be assigned in conjunction with the specific descriptor for the material used in a reactor, provided this descriptor is not yet up-posted to reactor materials.*
Laboratory evaluations of cobalt-free, nickel-based hard-facing alloys for nuclear applications: Topical report, 12:37219 (R;US)
**Embrittlement**
Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
**Materials Testing**
Tests of candidate materials for particle bed reactors, 12:36780 (R;US)
**Physical Radiation Effects**
Design and use of the Embrittlement Data Base (EDB), 12:36802 (R;US)
**REACTOR OPERATION**
*See also REACTOR START-UP*
**Compiled Data**
Licensee event report (LER) compilation for month of January 1987, 12:36795 (R;US)
**Data Compilation**
Licensee event report (LER) compilation: For month of April 1987, 12:36797 (R;US)
Licensee event report (LER) compilation for month of February 1987, 12:36796 (R;US)
**REACTOR OPERATORS**
**Reliability**
Accident Sequence Evaluation Program: Human reliability analysis procedure, 12:36925 (R;US)
**Training**
Emergency response training with the BNL plant analyzer, 12:36811 (R;US)
**REACTOR SAFETY**
**R Codes**
RELAP5/MOD2 development, 12:36866 (RA;US)
Swedish experience with RELAP5/MOD2 assessment, 12:36874 (RA;US)
**Research Programs**
List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: October 1-December 31, 1986. Progress report, 12:36830 (R;DE;In German)
Nuclear safety—forward on technology and backward on perception, 12:36889 (RA;US)
Role of oversight within NRR and its effect on industry, 12:36893 (RA;US)
**T Codes**
Status of the TRAC-BWR Program, 12:36865 (RA;US)
TRAC code development status and plans, 12:36867 (RA;US)
**REACTOR SHUTDOWN**
**Data Compilation**
Analysis of balance-of-plant regulatory issues: Final report, 12:36926 (R;US)
**REACTOR START-UP**
**Computerized Simulation**
Analysis of the start-up and control of a particle bed reactor, 12:36779 (R;US)
**READOUT SYSTEMS**
Accurate 2 dimensional drift tube readout using time division and vernier pads, 12:37571 (J;NL)
**RECEIVERS (SOLAR)**
*See SOLAR RECEIVERS*
**RECHARGE**
**Water Wells**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
**RECIPROCAL TRANSLOCATIONS**
*See CHROMOSOMAL ABERRATIONS*
**RECLAMATION**
*See LAND RECLAMATION*
**RECREATIONAL VEHICLES**
*See also MOTORBOATS*
**Motorboats**
Report to Congress on the gasoline excise-tax revenues attributable to fuel used in recreational motorboats, 12:36955 (R;US)
**RECYCLING**
**Economics**
The economic feasibility of plastics recycling, 12:37129 (R;US)
**RECYCLING (FUEL)**
*See REPROCESSING*
**REDUCTASES**
*See OXIDOREDUCTASES*
**REDUCTION**
*For chemical reactions only.*
**Catalysts**
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**REFORMER PROCESSES**
*See also STEAM REFORMER PROCESSES*
**Catalysts**
Peat-bio-gasification. Progress report stage 8 1985-07-01-1986-06-30, 12:36277 (R;SE;In Swedish)
**REFRIGERATORS**
*See also SOLAR REFRIGERATORS*
**Compressors**
Efficient refrigerators with small compressors, 12:37075 (R;DK;In Danish)
**Energy Consumption**
Energy use test procedures for appliances: A case study of Japanese refrigerators, 12:37027 (R;US)
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
Energy use test procedures for appliances: A case study of Japanese refrigerators, 12:37027 (R;US)
**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**REFUSE**
*See SOLID WASTES*
**REFUSE DERIVED FUELS**
**Combustion**
Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
**REFUSE-FUELED BOILERS**
**Air Pollution Control**
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)
**Combustion Control**
Waste fuels: A proven source of energy recovery, 12:36608 (BA;US)
**Combustors**
Waste fuels: A proven source of energy recovery, 12:36608 (BA;US)
**REGION I**
*See FEDERAL REGION I*

**RELATIVITY THEORY**
NRL (Naval Research Laboratory) plasma formulary, (revised), 12:38098 (R;US)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final technical report, 15 December 1982-14 January 1987, 12:38089 (R;US)
Relativistic calculations and measurements of energies, Auger rates, and lifetimes. Final report, 15 January 1984-14 January 1985, 12:38088 (R;DE)
**Quantum Mechanics**
On the discrete reconciliation of relativity and quantum mechanics, 12:38310 (R;US)
**Training**
Spontaneous ideas about the speed of light, 12:38395 (R;BR)
**RELAYS**
**Computerized Control Systems**
Adaptive transmission system relaying, 12:36768 (R;US)
**REMEDIAL ACTION**
**Environmental Impacts**
Environmental Assessment of remedial action at the Ambrosia Lake uranium mill tailings site, Ambrosia Lake, New Mexico, 12:36552 (R;US)
**Program Management**
Superfund innovative technology evaluation (site) strategy and program plan, 12:37811 (R;US)
**Technology Assessment**
DOE Hazardous Waste Remedial Actions Program: Annual report, FY 1986, 12:36959 (R;US)
**RENEWABLE ENERGY SOURCES**
*See also BIOMASS*
*GEOTHERMAL ENERGY*
*HYDROELECTRIC POWER*
*SOLAR ENERGY*
*TIDAL POWER*
*WIND POWER*
**Energy Source Development**
Contribution of renewable energy technologies to future energy requirements, 12:37004 (J;GB)
**Forecasting**
Contribution of renewable energy technologies to future energy requirements, 12:37004 (J;GB)
**Manuals**
Alternative energy sources guidebook. Final report, 12:37003 (R;US)
**Technology Assessment**
Alternative energy sources guidebook. Final report, 12:37003 (R;US)
**REPROCESSING**
*See also PUREX PROCESS*
**Research Programs**
Consolidated Fuel Reprocessing Program: Progress report for period October 1 to December 31, 1986, 12:36488 (R;US)
**REPUBLIC OF CHINA**
*See TAIWAN*
**RESEARCH AND TEST REACTORS**
**Research Programs**
Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**Reverse-Field Pinch**
Compact reactor studies: Technical progress report, 1 December 1986 through 30 November 1987, 12:38377 (R;US)
**RESEARCH PROGRAMS**
*To be used jointly with descriptor(s) for subject field and/or organization concerned.*
**Catalogs**
National Register of research projects: Part 1, Natural sciences: Biological, medical and related sciences, 12:38397 (R;ZA;In Afrikaans and English)
**RESERVE CAPACITY**
*See CAPACITY*
**RESERVOIR ROCK**
**Density**
The GRI staged field experiment, 12:36440 (BA;US)
**Fracture Properties**
Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
The influence of fracture toughness on the geometry of hydraulic fractures, 12:36394 (BA;US)
**Gas Flow**
The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
**Gas Saturation**
Recovery efficiency aspects of horizontal well drilling in Devonian shale, 12:36434 (BA;US)
**Hydraulic Conductivity**
New methods for estimating parameters of low permeability reservoirs, 12:36407 (BA;US)
**Hydraulic Fractures**
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**Lithology**
The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)
**Mathematical Models**
Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
**Measuring Methods**
Reliability of laboratory measurement of porosity in tight gas sands, 12:36432 (BA;US)
**Microstructure**
The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
**Permeability**
Low-permeability reservoirs development using horizontal wells, 12:36402 (BA;US)
Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
The GRI staged field experiment, 12:36440 (BA;US)
**Porosity**
Reliability of laboratory measurement of porosity in tight gas sands, 12:36432 (BA;US)
Reservoir properties required for profitable stimulations, 12:36450 (BA;US)
The effect of pore structure on non-Darcy gas flow in some low-permeability reservoir rocks, 12:36433 (BA;US)
**Pressure Effects**
The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)
**Pressure Gradients**
Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
**Rock-Fluid Interactions**
Mechanisms controlling fracture height growth in layered media, 12:36392 (BA;US)
Realistic fracture conductivities of proppants as a function of reservoir temperature, 12:36389 (BA;US)
**Stress Analysis**
In-situ stresses in low-permeability, nonmarine rocks, 12:36404 (BA;US)
The effects of lithology and reservoir pressure on the in-situ stresses in the Waskom (Travis Peak) field, 12:36454 (BA;US)
**RESERVOIRS (WATER)**
*See WATER RESERVOIRS*
**RESID**
*See PETROLEUM RESIDUES*
**RESIDENCES**
*See HOUSES*
**RESIDENTIAL BUILDINGS**
*See also APARTMENT BUILDINGS*
*HOUSES*
*MOBILE HOMES*
**Aerosol Monitoring**
Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
**Air Heaters**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)

**Building Codes**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report], 12:37065 (R;US)
**Construction**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
**Electric Heating**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
Occupant influence on energy consumption in single-family dwellings, 12:37019 (R;SE)
**Energy Conservation**
Energy conservation business opportunities in multifamily housing: Executive summary and conclusions: [Final report], 12:37061 (R;US)
Energy conservation business opportunities in multifamily housing: Feasibility analysis/business plan for proposed residential balancing venture: [Final report], 12:37062 (R;US)
**Energy Consumption**
Occupant influence on energy consumption in single-family dwellings, 12:37019 (R;SE)
**Energy Efficiency**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 2, Building code, construction and energy efficiency issues: [Final report], 12:37064 (R;US)
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 1, Industry assessment and business concept paper: [Final report], 12:37063 (R;US)
**Energy Efficiency Standards**
Energy conservation business opportunities in multifamily housing: Energy-efficient manufactured housing in Chicago: Part 3, Building code and energy efficiency appendices: [Final report], 12:37065 (R;US)
**Heat Pumps**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)
Projecting market demand for residential heat pumps, 12:37018 (R;US)
**Heating Systems**
1985 primary heating fuel use and switching: Assessment of the market for conservation in the Northwest: Phase 2, 12:37080 (R;US)
Energy conservation business opportunities in multifamily housing: Feasibility analysis/business plan for proposed residential balancing venture: [Final report], 12:37062 (R;US)
Evaluation of gas heating system retrofit pilot programs in Minnesota and Kentucky, 12:37026 (R;US)
**Indoor Air Pollution**
Some results from the demonstration of indoor radon reduction measures in block basement houses. Report for June 1985-February 1987, 12:37720 (R;US)
Statistical aspects of autoregressive models in the assessment of radon mitigation, 12:37717 (R;US)
Study on indoor air impurities, 12:37089 (R;FI;In Finnish)
**Monitoring**
Weatherization assistance program: Final monitoring report for Arizona; California; the Navajo Nation; Nevada, 12:37067 (R;US)
**Solar Water Heating**
A design method for thermosyphon solar domestic hot water systems, 12:36688 (J;US)
**Weatherization**
Energy conservation business opportunities in multifamily housing: Executive summary and conclusions: [Final report], 12:37061 (R;US)
Weatherization assistance program: Final monitoring report for Arizona; California; the Navajo Nation; Nevada, 12:37067 (R;US)
**RESIDENTIAL SECTOR**
**Energy Conservation**
Overview of the heat loss study for the Hood River Conservation Project, 12:37060 (RA;US)
Technology diffusion of energy-related products in residential markets, 12:37081 (R;US)
**Energy Consumption**
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Energy Expenses**
Thermal and cost comparison of six superinsulated houses and one passive solar house in the Idaho residential demonstration program, 12:37045 (RA;US)
Trends in consumption and expenditures, 1978-1984: Residential Energy Consumption Survey, 12:37002 (R;US)
**Heat Pumps**
Minority participation in new energy technologies: A case example of electric heat pumps, 12:37024 (R;US)
**Repair**
Energy related business development project: Final report (Remodeling/repair business), 12:38391 (R;US)
**RESIDUAL FUEL OIL**
*See RESIDUAL FUELS*
**RESIDUAL FUELS**
1986 fuel oil utilization workshop: Proceedings, 12:36429 (R;US)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**RESIDUAL HEAT REMOVAL**
*See RHR SYSTEMS*
**RESIDUAL OILS**
*See PETROLEUM RESIDUES*
**RESIDUAL STRESSES**
**Finite Element Method**
FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements (Finite element analysis), 12:37244 (R;US)
**RESIDUES (RADIOACTIVE)**
*See RADIOACTIVE WASTES*
**RESIDUUMS**
*See RESIDUAL FUELS*
**RESINS**
**Production**
Control technology for falling solids at Rohm and Haas, Louisville, Kentucky. Final report, 12:37699 (R;US)
**RESISTIVITY (ELECTRIC)**
*See ELECTRIC CONDUCTIVITY*
**RESOURCE CONSERVATION**
**Institutional Factors**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)
**RESOURCE DEVELOPMENT**
**Cost**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Investment**
Optimal investments using empirical dynamic programming with application to natural resources, 12:36436 (R;NO)
**Water Rights**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)
**RESOURCE RECOVERY ACTS**
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)

**RESPIRABLE DUSTS**
*See DUSTS*
**RESPIRATORY SYSTEM**
*See also LUNGS*
**Antioxidants**
Pulmonary antioxidants, 12:38004 (R;US)
**Dynamic Function Studies**
Effect of continuous positive and negative pressure breathing on the respiratory pattern of conscious rats, 12:37885 (RA;US)
**Scintiscanning**
Technique for aerosol deposition restricted to the nose in Beagle dogs, 12:37961 (RA;US)
**Sensitivity**
Airway sensitivity of asthmatics to sulfur dioxide, 12:37994 (R;US)
**RESPIRATORY SYSTEM DISEASES**
*See also ASTHMA*
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)
**Radioinduction**
Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. X, 12:37922 (RA;US)
Toxicity of $^{144}Ce$ inhaled in a relatively insoluble from by immature Beagle dogs. XV, 12:37914 (RA;US)
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs: A. Monodisperse 1.5 $\mu$ AMAD particles. B. Monodisperse 3.0 $\mu$m particles. XIII, 12:37918 (RA;US)
Toxicity of $^{239}PuO_2$ in immature Beagle dogs. VIII, 12:37920 (RA;US)
**RESTRAINTS**
**Inspection**
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Seismic Effects**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**RETINOL**
*See VITAMIN A*
**RETORTING**
*See also IN-SITU RETORTING*
**Waste Water**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**RETORTS**
**Design**
Application of laboratory results to the design of a high yield VMIS oil shale retort, 12:36471 (B;US)
Lawrence Livermore National Laboratory Oil Shale Project: Quarterly report, January-March 1987, 12:36470 (R;US)
**REVERSE COMBUSTION**
**Bench-Scale Experiments**
Reverse combustion in asphalt ridge tar sand, 12:36468 (R;US)
**REVERSE-FIELD PINCH**
**Tearing Instability**
Nonlinear dynamics of tearing modes in the reversed field pinch, 12:38332 (R;US)
**RHENIUM 187**
**Beta-Minus Decay**
Laboratory determination of the half-life of $^{187}Re$, a nuclide of cosmological interest, 12:38257 (BA;DE)
**RHENIUM ALLOYS**
**Energy Gap**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
**Superconductivity**
Electron-tunneling studies of Mo/sub 1-x/Re/sub x/: enhancement of superconductivity by a resonance mode, 12:37275 (D;US)
**RHODIUM**
**Chemical Reactions**
A TEM [transmission electron microscopy] study of rhodium on GaAs: Reactions and morphology, 12:37514 (R;US)
**RHODIUM ALLOYS**
**Kondo Effect**
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**RHODIUM COMPLEXES**
**Catalytic Effects**
Transition metal catalyzed transformations of unsaturated molecules: Progress report for the period August 1, 1984-January 31, 1987, 12:37393 (R;US)
**RHODOPSIN**
**Biochemical Reaction Kinetics**
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**Laser Spectroscopy**
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**Structure-Activity Relationships**
[Mechanism of proton pumping by bacteriorhodopsin], 12:36625 (R;US)
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**RHR SYSTEMS**
**Outages**
Precursors to potential severe core damage accidents, 1984: A status report: Appendixes C, D, and E, 12:36922 (R;US)
**RICHLAND FFTF REACTOR**
*See FFTF REACTOR*
**RICHLAND NPR REACTOR**
*See N-REACTOR*
**RIEMANN WAVES**
*See SHOCK WAVES*
**RINGS (STORAGE)**
*See STORAGE RINGS*
**RISER CRACKING**
*See COAL LIQUEFACTION*
**RISK ANALYSIS**
*See RISK ASSESSMENT*
**RISK ASSESSMENT**
**Decision Making**
Use of risk assessment methods in the certification of decontamination buildings, 12:37620 (RA;US)
**RIVERS**
**Aquatic Ecosystems**
Wild-life studies in the Alta watercourse. Survey report for 1982-1984 (Finnmark, Norway), 12:37766 (R;NO;In Norwegian)
**R Codes**
Pacific Northwest Rivers Study: Idaho information update and retrieval system: user's manual, 12:37834 (R;US)
**RIVETS**
*See FASTENERS*
**ROAD TRANSPORT**
**Environmental Impacts**
Environmental effects due to the use of conventional and innovating fuels for autotraction, 12:37607 (R;IT;In Italian)
**ROADS**
**Air Pollution**
ROADWAY: a numerical model for predicting air pollutants near highways. User's guide. Final report, 12:37624 (R;US)
**ROBOTS**
**Artificial Intelligence**
Monitor - The prelude to robotics, 12:38415 (BA;US)
**Computerized Simulation**
3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)

**Control**
Insertions using geometric analysis and hybrid force-position control on a PUMA 560 with VAL II, 12:37463 (R;US)
**Control Theory**
Insertions using geometric analysis and hybrid force-position control on a PUMA 560 with VAL II, 12:37463 (R;US)
**Data Transmission Systems**
Monitor - The prelude to robotics, 12:38415 (BA;US)
**Electronic Guidance**
3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)
**Image Processing**
3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)
**Monitors**
Monitor - The prelude to robotics, 12:38415 (BA;US)
**Navigation**
3-D world modeling based on combinatorial geometry for autonomous robot navigation, 12:36808 (BA;US)

**ROCK DRILLING**
**Test Facilities**
Investigation of rock drilling processes with diamond cutters of peg shape, 12:36374 (RA;DE;In German)

**ROCK SALT**
*See SALT DEPOSITS*

**ROCKET ENGINES**
**Materials Testing**
Kevlar/epoxy laminates: Mechanical response of as-fabricated and shock-loaded materials (Rocket motorcase materials), 12:37350 (R;US)

**ROCKETS**
**Propulsion Systems**
Low-thrust rocket trajectories, 12:36821 (R;US)
**Trajectories**
Low-thrust rocket trajectories, 12:36821 (R;US)

**ROCKS**
**Deformation**
A finite element material model for microfracture-damaged brittle rock (SANCHO code), 12:38047 (R;US)
**Dilatancy**
Brittle fracture phenomena: An hypothesis, 12:38048 (R;US)
**Explosive Fracturing**
Brittle fracture phenomena: An hypothesis, 12:38048 (R;US)
**Fluid Flow**
Channel model of flow through fractured media, 12:37829 (J;US)
**Fractures**
Generation and analysis of stable excavation shapes under high rock stresses, 12:38044 (R;US)
**Fragmentation**
A new constitutive model for fragmentation of rock under dynamic loading, 12:36467 (R;US)
Confined volume blasting experiments: Description and analysis, 12:36466 (R;US)
**S Codes**
A finite element material model for microfracture-damaged brittle rock (SANCHO code), 12:38047 (R;US)
**Structural Models**
Nevada Nuclear Waste Storage Investigations Project: Analysis of horizontal waste emplacement boreholes of a nuclear waste repository in tuff (NNWSI), 12:36538 (R;US)

**ROCKY FLATS PLANT**
**Fuel Reprocessing Plants**
Recovery of transuranics from process residues, 12:36513 (R;US)
**Radiation Monitoring**
Annual Environmental Monitoring report, January through December 1986, 12:37723 (R;US)

**ROD BUNDLES**
**Dryout**
Dryout front modeling for rod bundles, 12:36852 (RA;US)

**RODS (FUEL)**
*See FUEL RODS*

**ROOFS**
**Passive Solar Heating Systems**
Determination of R-values from in-situ dynamic thermal test data in light weight roof systems, 12:36690 (BA;US)
**Recycling**
Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing, 12:37139 (R;US)
**Solar Architecture**
Determination of R-values from in-situ dynamic thermal test data in light weight roof systems, 12:36690 (BA;US)
**Thermal Efficiency**
Determination of R-values from in-situ dynamic thermal test data in light weight roof systems, 12:36690 (BA;US)

**ROOM AND PILLAR MINING**
**Mechanical Structures**
Improved stopping, door, and overcast construction for oil-shale mines. Open File report, June 1984-September 1986, 12:36465 (R;US)

**ROTARY DRILLING**
**Drill Bits**
Initial testing and resulting redesign of the 96-inch diameter Robbins Disc Cutter Bit at the Nevada Test Site, 12:37455 (R;US)

**ROTORS**
**Frequency Control**
Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades, 12:36757 (R;SE)
**Microstructure**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Torque**
Stator current frequency spectra and torque pulsations in induction machines with rotor convertor cascades, 12:36757 (R;SE)
**Ultrasonic Testing**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)

**RUBBERS**
**Combustion Products**
Health-hazard evaluation report HETA 86-477-1755, Cumberland County Homemaker Home Health Aid Service, Bridgeton, New Jersey, 12:37700 (R;US)
**Manufacturing**
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio, 12:37696 (R;US)

**RUBIDIUM COMPOUNDS**
**Glass**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)
**Isotope Effects**
Pressure-induced suppression of the proton-glass phase and isotope effects in Rb/sub 1-//sub x/$(NH_4)$/sub x/$H_2PO_4$, 12:37354 (J;US)

**RURAL AREAS**
**BIOGAS Process**
Chinese biogas digester: a potential model for small-scale, rural applications (a manual for construction and operation), 12:36590 (R;US)
**Waste Water**
Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)

**RUTHENIUM**
**Catalyst Supports**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**Catalytic Effects**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 5 for the period 1 October to 31 December 1986, 12:36583 (R;US)
**Chemical Preparation**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)

**Morphology**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**Sulfidation**
Effects of presulfidization on the activity, selectivity and morphology of supported ruthenium catalysts, 12:37425 (B;US)
**RUTHENIUM ALLOYS**
**Melting Points**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)
**Phase Studies**
Metastable phase boundaries of quasicrystalline phases (Al-Mn; Al-Ru), 12:37240 (R;US)

## S

**S CODES**
A finite element material model for microfracture-damaged brittle rock (SANCHO code), 12:38047 (R;US)
SUNBURN: A computer code for evaluating the economic viability of hybrid solar central receiver electric power plants, 12:36656 (R;US)
Verification report for SIMREP 1.1, 12:36499 (R;US)
**SAFEGUARDS**
**Surveillance**
Semi-automated reviewing station for IAEA [International Atomic Energy Agency] optical surveillance data, 12:36568 (R;US)
**SAFETY**
*For general aspects of safety and protection of personnel.*
*See also OCCUPATIONAL SAFETY*
*REACTOR SAFETY*
An environmental source book on the photovoltaics industry, 12:36958 (R;US)
**SAFETY ENGINEERING**
Radiation alarms and access control systems: Recommendations of the National Council on Radiation Protection and Measurements, 12:37459 (R;US)
**SAFETY (NUCLEAR)**
*See RADIATION PROTECTION*
**SAFETY (REACTOR)**
*See REACTOR SAFETY*
**SALINE ZONE**
*See OIL SHALES*
**SALT CAVERNS**
**Monitoring**
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**Pressure Measurement**
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**Pressurizing**
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**SALT DEPOSITS**
**High-Level Radioactive Wastes**
Quarterly brine migration data report, October-December 1983: Nuclear Waste Repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36496 (R;US)
**Radioactive Waste Disposal**
Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
**Temperature Effects**
Quarterly brine migration data report, April-June 1984: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany, 12:36497 (R;US)
**SAMARIUM 148 TARGET**
**Oxygen 16 Reactions**
Angular momentum effects in subbarrier fusion, 12:38251 (R;US)
**SAMPLING**
**Recommendations**
Sampling for branch, tree and stand estimates of crown biomass, 12:37786 (RA;DE)
**SAND**
**Fluidized Beds**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Particle Size**
Effects of bed material on behaviour and dimensioning of steam fluidized bed dryer of milled peat, 12:36363 (R;FI;In Finnish)
**Permeability**
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions (Sandpack), 12:36384 (R;US)
**Porosity**
Two dimensional displacement of oil by gas and surfactant solution under foaming conditions (Sandpack), 12:36384 (R;US)
**SANITARY LANDFILLS**
**Degassing**
Recovery and utilization of landfill gas at the landfill 'Am Lemberg', Landkreis Ludwigsburg. Pt. 3. Results of the investigation program. Final report, 12:36580 (R;DE;In German)
**Leachates**
Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)
**Liners**
Minimum-technology guidance on single-liner systems for landfills, surface impoundments, and waste piles - design, construction, and operation. Draft report 1982-85, 12:37809 (R;US)
**Physical Properties**
Gas pressure and concentration gradients at the top of a landfill, 12:37824 (R;US)
**SARCOMAS**
**Radioinduction**
Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of $^{144}Ce$. XII, 12:37916 (RA;US)
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
**SAVANNAH RIVER PLANT**
**Accidents**
[Plutonium accumulation in tank (DPSPU-85-272-35)], 12:36556 (R;US)
**Environment**
Environmental information document: New hazardous and mixed waste storage/disposal facilities at the Savannah River Plant, 12:36514 (R;US)
Environmental information document: Y Area, 12:36549 (R;US)
**Environmental Impacts**
Environmental information document: Y Area, 12:36549 (R;US)
**Fuel Reprocessing Plants**
Recovery of transuranics from process residues, 12:36513 (R;US)
**Ground Water**
Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste, 12:36510 (R;US)
**Nuclear Materials Management**
A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)
**Radioactive Waste Disposal**
Organic compounds at the SRP [Savannah River Plant] old burial ground for low-level radioactive waste, 12:36510 (R;US)

**Radioactive Waste Processing**
Design of agitation systems in Bingham slurries by pilot simulation, 12:36511 (R;US)
Design of saltstone vaults, 12:36512 (R;US)
**Remote Sensing**
Remote sensing at Savannah River, 12:37825 (R;US)
**Waste Management**
Environmental information document: Y Area, 12:36549 (R;US)

**SCANDIUM 45 TARGET**
**Oxygen 18 Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)

**SCATTERING**
**S Matrix**
Algebraic approach to scattering and the Euclidean connection, 12:38212 (BA;US)

**SCHOOL BUILDINGS**
**Asbestos**
Bibliography on asbestos in schools, 12:37687 (R;US)
**Geothermal Heating Systems**
Report on an investigation to assess the potential and cost effectiveness of geothermal heating for Lindsey Comprehensive School, Cleethorpes, 12:36729 (R;GB)

**SCHOOL FACILITIES**
*See EDUCATIONAL FACILITIES*

**SCHOOL PLANT**
*See EDUCATIONAL FACILITIES*

**SCHOOLS**
*See EDUCATIONAL FACILITIES*

**SCHOTTKY BARRIER DIODES**
**Fabrication**
Mechanism of Schottky barrier formation: The role of amphoteric native defects, 12:37357 (J;US)

**SCIENTIFIC PERSONNEL**
**Training**
Spontaneous ideas about the speed of light, 12:38395 (R;BR)

**SCOTLAND**
*See UNITED KINGDOM*

**SCRAP METALS**
**Cutting**
Hot tests of the small portable arc saw using an electromechanical manipulator, 12:36935 (BA;US)
**Radioactivity**
Hot tests of the small portable arc saw using an electromechanical manipulator, 12:36935 (BA;US)

**SCREWS**
*See FASTENERS*

**SCRUBBERS**
**Design**
Design procedure for sizing a submerged-bed scrubber for airborne particulate removal, 12:37722 (R;US)
**Operation**
Design procedure for sizing a submerged-bed scrubber for airborne particulate removal, 12:37722 (R;US)
**Performance**
Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for September 1985-April 1986, 12:37653 (R;US)

**SEA DISPOSAL**
*See MARINE DISPOSAL*

**SEACOAST**
*See SHORES*

**SEALS**
High-temperature burner-duct-recuperator (HTBDR) system low-pressure seal development: Final report, 12:37138 (R;US)
**Design**
High-temperature rotating shaft seal, 12:36253 (RA;US)
**Performance Testing**
High-temperature rotating shaft seal, 12:36253 (RA;US)
Small-Scale Seal Performance Test Series "A" thermal/structural data through the 180th day (Concrete seals), 12:37347 (R;US)

**SECONDARY BATTERIES**
*See ELECTRIC BATTERIES*

**SECONDARY RECOVERY**
*See ENHANCED RECOVERY*

**SECURITY**
The Livermore Security Console system, 12:36572 (R;US)

**SEDIMENTS**
**Environmental Transport**
Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)
**Yields**
Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)

**SEEDLINGS**
**Biological Stress**
Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions, 12:37952 (RA;US)
**Plant Growth**
Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions, 12:37952 (RA;US)

**SEISMIC ARRAYS**
**Nuclear Explosion Detection**
Technical report for the period 1 October-31 December 1986, 12:37597 (R;US)

**SEISMIC EFFECTS**
**Calculation Methods**
Comparison of a quasistatic seismic strain range method with test and detailed transient analysis, 12:36831 (R;US)
**Research Programs**
Seismic safety research program plan, 12:36834 (R;US)

**SEISMIC SOURCES**
**Computerized Simulation**
Numerical simulation of marine seismic source signature and of their interaction. Application to the watergun, 12:38042 (R;FR;In French)

**SELENIUM 82**
**Double Beta Decay**
A /sup 82/Se double Beta decay experiment, 12:38249 (BA;US)

**SELENIUM ALLOYS**
**Chemical Preparation**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Crystal Defects**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**Neutron Diffraction**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)
**X-Ray Diffraction**
Synthesis and powder diffraction study of a pyrite-like phase in the Ir-Se system, 12:37257 (J;US)

**SELENIUM COMPOUNDS**
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Synthesis**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)

**SEMICONDUCTOR DEVICES**
*See also SEMICONDUCTOR DIODES*
**Electric Contacts**
Ion beam characterization of thin film metal/GaAs interface reactions, 12:37513 (R;US)
**Uses**
Ultrahigh vacuum studies of Pd metal/insulator/semiconductor diode $H_2$ sensors, 12:37520 (J;US)

**SEMICONDUCTOR DIODES**
*See also SCHOTTKY BARRIER DIODES*
Thin-film palladium and silver alloys and layers for metal-insulator-semiconductor sensors, 12:37519 (J;US)

**SEMICONDUCTOR MATERIALS**
*If possible index also the specific compounds.*

**Gallium Arsenides**
Preliminary survey report: control technology for gallium arsenide processing at Microwave Semiconductor Corporation, Somerset, New Jersey, 12:37677 (R;US)
**Magneto-Optical Effects**
Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986, 12:38297 (R;US)
**SENIOR CENTERS**
*See PUBLIC BUILDINGS*
**SEPARATION PROCESSES**
*See also CENTRIFUGATION*
*FLOTATION*
*HEAVY MEDIA SEPARATION*
*PRECIPITATION SCAVENGING*
*REPROCESSING*
**Energy Conservation**
Industrial applications of freeze concentration technology: Final report, 12:37143 (R;US)
**Membranes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)
**SEPARATORS (STEAM)**
*See STEAM SEPARATORS*
**SEQUOYAH NUCLEAR POWER PLANT UNIT-1**
*See SEQUOYAH-1 REACTOR*
**SEQUOYAH NUCLEAR POWER PLANT UNIT-2**
*See SEQUOYAH-2 REACTOR*
**SEQUOYAH-1 REACTOR**
*Daisy, Tennessee, USA*
**Environmental Effects**
Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
**SEQUOYAH-2 REACTOR**
*Daisy, Tennessee, USA*
**Environmental Effects**
Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
**SEWAGE SLUDGE**
**Marine Disposal**
Practical manual for determining settling rates of ocean-disposed sewage sludge. Technical memo, 12:37842 (R;US)
**Pollutants**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)
**SHALE MINING**
*See OIL SHALE MINING*
**SHALE OIL**
**Chemical Composition**
Combined gas chromatography/mass spectrometric evaluation of selected isothermally produced shale oils, 12:36475 (R;US)
**Combustion**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**Cracking**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**Marketing Research**
Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 2, 12:36477 (R;US)
**Oil Yields**
Evaluation of separate diagnostic correlations for cracking and combustion losses during oil shale retorting, 12:36469 (R;US)
**SHALES**
**Chemical Composition**
A review of the organic geochemistry of shales, 12:36526 (R;US)
**Hydraulic Conductivity**
Permeability of shale at elevated temperature and pressure: Test methodology and preliminary results, 12:36522 (R;US)
**SHALLOW LAND BURIAL**
*See GROUND DISPOSAL*
**SHATTERING**
*See FRAGMENTATION*
**SHEATHS (FUEL)**
*See FUEL CANS*
**SHIELDS**
**Mass**
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
**SHIPS**
**Antennas**
Numerical assessment of high frequency (HF) antennas for shipboard use, 12:37466 (R;US)
**Military Personnel**
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 2. (Appendix A) target ships. Technical report, 12:37591 (R;US)
Analysis of radiation exposure for naval units of Operation Crossroads. Volume 3. (Appendix B) support ships. Technical report, 12:37592 (R;US)
**SHOCK WAVES**
*See also DETONATION WAVES*
**Biological Effects**
Pressure and intracorporal acceleration measurements in pigs exposed to strong shock waves in a free field, 12:38015 (TG;US)
**SHORES**
*For both lake- and sea-land boundaries.*
**Pollution Control**
Follow-up studies of areas which have been polluted by oil, 12:36423 (R;NO;In Norwegian)
**SHOWER COUNTERS**
*Detects high energy gamma radiation or high energy particles on basis of cascade showers in layered absorbers.*
**Trigger Circuits**
Granlibakken report on the SSP Trigger, 12:37550 (RA;US)
**SHRUBS**
**Population Dynamics**
Modifications of the Adesmia horrida bushes due to snow weight at the Paramillo de Uspallata, Mendoza, Argentina, 12:37743 (RA;US)
**SHUTDOWN (REACTOR)**
*See REACTOR SHUTDOWN*
**SHUTTLE CARS**
*See TRACKLESS VEHICLES*
**SIALON**
*See ALUMINIUM OXIDES*
*SILICON NITRIDES*
**SID**
*See SUDDEN IONOSPHERIC DISTURBANCE*
**SIGMA NEUTRAL**
**Particle Production**
Measurement of the ratio of Σ0 to Λ° inclusive production from 28.5-GeV/c protons on beryllium, 12:38151 (J;US)
**SIGNALS**
**Validation**
Signal validation in nuclear power plants: Progress report No. 2, 12:36813 (R;US)
Signal validation in nuclear power plants: Progress report No. 1, 12:36812 (R;US)
**SILANES**
**Chemical Reaction Kinetics**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)
**Chemical Vapor Deposition**
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)

**Hydrolysis**
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**Ion-Molecule Collisions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Mathematical Models**
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)
**Nuclear Magnetic Resonance**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
**Phase Transformations**
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)
**Photochemical Reactions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**Sol-Gel Process**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**Thermal Degradation**
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)

**SILICA**
**Air Flow**
Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)
**Brittleness**
Packing-induced brittleness in polyimide- and aluminum-clad fused-silica capillaries, 12:37358 (J;US)
**Catalytic Effects**
Transient temperature technique applied to study activity pattern changes during the hydrogenation of CO over nickel/silica catalysts, 12:36594 (J;US)
**Chemical Reaction Kinetics**
Kinetic investigations of alkoxysilane sol-gel processing, 12:37312 (BA;US)
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
**Computerized Simulation**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Crystal Growth**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Hydrolysis**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
**Molecular Structure**
Growth and structure of fractally rough silica colloids, 12:37429 (BA;US)
**Polymerization**
Fractal aspects of ceramic synthesis, 12:37321 (BA;US)
**Sol-Gel Process**
Kinetic investigations of alkoxysilane sol-gel processing, 12:37312 (BA;US)
**Structural Chemical Analysis**
Fractal aspects of ceramic synthesis, 12:37321 (BA;US)
**Surface Properties**
Fractal aspects of ceramic synthesis, 12:37321 (BA;US)
**Thermodynamic Properties**
Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)

**SILICA GEL**
**Microstructure**
Microstructural studies of transparent silica gels and aerogels, 12:37322 (BA;US)
**Opacity**
Microstructural studies of transparent silica gels and aerogels, 12:37322 (BA;US)

**SILICATES**
*See also ALUMINIUM SILICATES*
*GARNETS*
*LITHIUM SILICATES*
**Chemical Preparation**
Silicate precursors: chemical kinetics, 12:37407 (R;US)
**Chemical Reaction Kinetics**
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
**Hydrolysis**
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)

**SILICIC ACID**
**Chemical Preparation**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)
**Structural Chemical Analysis**
A molecular building-block approach to the synthesis of ceramic materials, 12:37319 (BA;US)

**SILICIDES**
*See also IRON SILICIDES*
*MANGANESE SILICIDES*
**Ionic Conductivity**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)

**SILICON**
**Crystal Defects**
Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon, 12:37352 (J;US)
**Deposition**
High-rate deposition of hydrogenated amorphous silicon films and devices, 12:36636 (R;US)
**Energy-Level Density**
Density-of-states calculations within the recursion method, 12:38303 (J;US)
**Ion Implantation**
Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals, 12:38296 (R;US)
Oxidation of Ge-implanted silicon, 12:37332 (R;US)
**Neutron Diffraction**
Mirror and Bragg reflections of neutrons at a nuclear resonance: [Final technical report], 12:38292 (R;US)
**Oxidation**
Oxidation of Ge-implanted silicon, 12:37332 (R;US)
**Photoconductivity**
Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon, 12:37352 (J;US)
**Production**
Theoretical modeling and laser diagnostics of silicon chemical vapor deposition, 12:37430 (B;US)
**Recombination**
Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon, 12:37352 (J;US)
**Solar Energy Conversion**
Solar power absorption in a glass tube, 12:36704 (R;US)
**Structural Chemical Analysis**
Exafs and neutron scattering determination of local order in a-Si:H, 12:37330 (R;FR)
**Temperature Distribution**
Equilibrium temperature and related defects in intrinsic glow discharge amorphous silicon, 12:37352 (J;US)
**Transmission Electron Microscopy**
Evaluation of local strain fields at [001] twist boundaries in silicon with transmission electron microscope diffraction: Final subcontract report, 12:36635 (R;US)

**SILICON 28 TARGET**
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Experimental studies of nucleon-nucleon and pion-nucleus interactions at intermediate energies: Progress report, January 1, 1985-December 31, 1987, 12:38238 (R;US)
Studies of hypernuclei by associated production, 12:38237 (R;US)
**SILICON CARBIDES**
Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
**Chemical Vapor Deposition**
Effect of infiltration conditions on the properties of SiC/Nicalon composites, 12:37301 (R;US)
**Corrosion Resistance**
Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
**Crystal Growth**
Whisker reinforced structural ceramics: Progress in the VLS growth and use of long silicon carbide whiskers (Vapor-liquid-solid), 12:37300 (R;US)
**Mechanical Properties**
Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
**Microstructure**
Antiphase boundaries in $\beta$-SiC thin films, 12:37289 (R;US)
**Oxidation**
Reliability of silicon carbide in combustion environments: Final report, 12:37297 (R;US)
**Production**
Production of fine, high-purity, beta SiC powder, 12:37282 (R;US)
**SILICON COMPOUNDS**
*See also SILANES, SILOXANES and SILICONES.*
*See also SILANES*
*SILICATES*
*SILICIDES*
*SILICON CARBIDES*
*SILICON NITRIDES*
*SILICON OXIDES*
**Chemical Reaction Kinetics**
High field /sup 1/H NMR studies of sol-gel kinetics, 12:37313 (BA;US)
**Electric Conductivity**
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
**Hydrolysis**
High field /sup 1/H NMR studies of sol-gel kinetics, 12:37313 (BA;US)
**Magnetic Susceptibility**
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
**NMR Spectra**
High field /sup 1/H NMR studies of sol-gel kinetics, 12:37313 (BA;US)
**Sol-Gel Process**
High field /sup 1/H NMR studies of sol-gel kinetics, 12:37313 (BA;US)
**SILICON HYDRIDES**
*See SILANES*
**SILICON IONS**
**Ion-Molecule Collisions**
The free-radical and ion chemistry of volatile silanes, germanes and phosphines: Annual informal technical report, November 1, 1986-May 31, 1987, 12:37432 (R;US)
**SILICON NITRIDES**
**Capacitors**
On ion induced hard errors in dielectric structures, 12:37516 (R;US)
**Fracture Properties**
Effect of flaws on the fracture behavior of structural ceramics, 12:37292 (R;US)
**Nondestructive Testing**
NDE [nondestructive evaluation] and fracture studies of hot-pressed $Si_3N_4$, 12:37285 (R;US)
**Tribology**
Mechanical interactions of rough surfaces: Quarterly progress report for period December 31, 1986 to March 29, 1987, 12:37296 (R;US)
**SILICON OXIDES**
*See also QUARTZ*
*SILICA*
**Capacitors**
On ion induced hard errors in dielectric structures, 12:37516 (R;US)
**Physical Radiation Effects**
Field dependence of geminate recombination in a dielectric medium. Final report, October 1974-September 1975, 12:37280 (R;US)
**SILICON SOLAR CELLS**
High-rate deposition of hydrogenated amorphous silicon films and devices, 12:36636 (R;US)
**Fabrication**
Continuous production of photovoltaic silicon ribbons by the new pendant drop growth (PDG) method, 12:36629 (R;XE)
**Performance**
Evaluation of local strain fields at [001] twist boundaries in silicon with transmission electron microscope diffraction: Final subcontract report, 12:36635 (R;US)
**Reviews**
Progress in photovoltaic concentrator research, 12:36644 (BA;US)
**Solar Concentrators**
Progress in photovoltaic concentrator research, 12:36644 (BA;US)
**SILOXANES**
**Chemical Reaction Kinetics**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**Hydrolysis**
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**Nuclear Magnetic Resonance**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
**Sol-Gel Process**
A solid state multinuclear magnetic resonance study of the sol-gel process using polysilicate precursors, 12:37318 (BA;US)
Studies of the initial steps in sol-gel processing of Si(OR)/sub 4/: /sup 29/Si NMR of alkoxysilane and alkoxysiloxane solutions, 12:37317 (BA;US)
**SILVER**
**Dielectric Properties**
Effect of liquids on the Drude dielectric function of Ag and Au films, 12:37251 (J;US)
**Nitrogen 14 Reactions**
Intermediate-mass fragments from nonbinary processes in the reaction of /sup 14/N on Ag at E/A = 35 MeV, 12:38254 (J;US)
**SILVER CHLORIDES**
**Thermodynamic Properties**
Thermodynamics of aqueous mixed potassium carbonate, bicarbonate, and chloride solutions to 368 K, 12:36948 (J;US)
**SILVER COMPOUNDS**
*See also SILVER CHLORIDES*
**Sorptive Properties**
Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)
**SIMS**
*See MASS SPECTROSCOPY*

**SKELETAL DISEASES**
**Diagnosis**
Mechanical and morphological evaluation of age-related changes in the Beagle spine, 12:37876 (RA;US)
**SKELETAL FOSSILS**
*See FOSSILS*
**SKELETON**
*See also VERTEBRAE*
**Carcinomas**
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
**Radiation Doses**
Toxic effects of inhaled $^{244}Cm_2O_3$ in rats. IV, 12:37926 (RA;US)
**Radionuclide Kinetics**
Biokinetics of $^{239}Pu$ in immature dogs that inhaled $^{239}PuO_2$, 12:37906 (RA;US)
Interactions of plutonium and americium with bone mineral, 12:37907 (RA;US)
**Sarcomas**
Radium-dial workers, 12:37935 (BA;US)
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
**SKIN DISEASES**
Health hazard evaluation report HETA 86-018-1758, Robbins and Myers, Incorporated, Moyno Products Division, Springfield, Ohio (Vitiligo), 12:37696 (R;US)
**SLAGS**
**X-Ray Diffraction**
Surface adhesion of low-rank coal ash: Quarterly report, January 1, 1987 to March 31, 1987, 12:36353 (R;US)
**SLC**
*See STANFORD LINEAR COLLIDER*
**SLIP FLOW**
**Finite Element Method**
Finite element analysis of flow in a gas-filled rotating annulus, 12:36482 (J;GB)
**SLOT OVENS**
*See COKE OVENS*
**SLUDGES**
*See also SEWAGE SLUDGE*
**Energy Recovery**
STORS: Battelle-Northwest's sludge-to-oil reactor system, 12:36589 (R;US)
**Incinerators**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**Materials Handling**
Materials used in low-level liquid waste reprocessing/treatment studies at Oak Ridge National Laboratory, 12:36502 (R;US)
**SLUGS (FUEL)**
*See FUEL RODS*
**SLURRIES (FUEL)**
*See FUEL SLURRIES*
**SLURRY PIPELINES**
**Economic Analysis**
Char-oil-water slurry study. Final report, 25 November 1985-28 February 1987, 12:36349 (R;US)
**Waste Water**
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
**SMALL BUSINESSES**
Code name: Opportunity battery: Phases 1 and 2 of Department of Energy Business Plan, 12:38392 (R;US)
**Marketing Research**
Energy related business development project: Final report (Remodeling/repair business), 12:38391 (R;US)
**SMALL-SCALE HYDROELECTRIC POWER PLANTS**
**Operation**
Small-scale hydroelectric demonstration project: Reactivation of the Elk Rapids Hydroelectric Facility: Final operation and maintenance report, 12:36615 (R;US)
**SMELTERS**
**Power Demand**
1986 variable industrial power rate: Executive summary of Administrator's Record of Decision, 12:36994 (R;US)
**SMOG**
**Photochemical Reactions**
Combined effects of organic reactivity and NMHC/NOx ratio on photochemical-oxidant formation - a modeling study, 12:37662 (R;US)
**SNG**
*See HIGH BTU GAS*
**SNOW**
**Environmental Effects**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Variations**
Modifications of the Adesmia horrida bushes due to snow weight at the Paramillo de Uspallata, Mendoza, Argentina, 12:37743 (RA;US)
**SODIUM**
**Chemical Analysis**
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
**SODIUM CHLORIDES**
**Activation Energy**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)
**Osmosis**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)
**Vapor Pressure**
Isopiestic determination of the osmotic and activity coefficients of aqueous mixtures of NaCl and MgCl/sub 2/ at 25°C, 12:37422 (J;US)
**SODIUM CITRATES**
*See SODIUM COMPOUNDS*
**SODIUM COMPOUNDS**
*See also SODIUM CHLORIDES*
*SODIUM SULFATES*
**Ionic Conductivity**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)
**Phosphorescence**
External heavy-atom effect in room-temperature phosphorescence, 12:37382 (J;US)
**SODIUM LAURYL SULFATES**
*See SODIUM COMPOUNDS*
**SODIUM MINERALS**
*See MINERALS*
**SODIUM SULFATES**
**Thermochemical Diagrams**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)
**SOILS**
**Biological Models**
Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document, 12:37816 (R;US)
**Carbon Cycle**
Carbon and carbon metabolism in the environment, 12:37905 (R;DE)
**Gases**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
**Land Pollution Abatement**
Approaches to the assessment of injuries to soil arising from discharges of hazardous substances and oil: Type B, Technical information document, 12:37816 (R;US)
**Liming**
Utilization of fluidized bed combustion waste: Final report, 12:37151 (R;US)
**Sewage Sludge**
Availability and distribution of heavy metals, nitrogen, and phosphorus from sewage sludge in the plant-soil-water continuum, 12:37840 (R;US)

**Sorptive Properties**
Adsorption of nitrogen-heterocyclic compounds on oxide surfaces: Final report for the period September 1, 1984-November 31, 1986, 12:37396 (R;US)
**Stabilization**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**Transfrontier Contamination**
Results of the activity measurements after the reactor accident in Chernobyl, 12:37710 (R;DE;In German)

**SOJA BEAN OIL**
*See SOYBEAN OIL*

**SOLAR ABSORBERS**
**Design**
Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
**Fabrication**
Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
**Surface Coating**
Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)

**SOLAR ACTIVITY**
*See also SOLAR FLARES*
*SOLAR PROMINENCES*
*SOLAR RADIO BURSTS*
*SUNSPOTS*
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**Computerized Simulation**
Vector-array-processor computer equipment. Final report, 1 January-31 December 1985, 12:38052 (R;US)
**Forecasting**
Forecasts of solar and geomagnetic activity, 12:38059 (RA;US)
NASA/MSFC prediction techniques, 12:38060 (RA;US)
**Gamma Radiation**
High-energy neutral radiations from the sun, 12:38051 (R;US)
**Measuring Instruments**
Very Large Array observations of the sun with related observations using the SMM (Solar Maximum Mission) satellite. Interim report, 1 January-31 December 1986, 12:38053 (R;US)
**Radio Noise**
VLA (Very Large Array) observations of a solar-noise storm, 12:38055 (R;US)
**Short Wave Radiation**
Simultaneous SMM flat-crystal spectrometer and Very Large Array observations of solar-active regions, 12:38056 (R;US)
Solar-active region physical parameters inferred from a thermal cyclotron line and soft-x-ray spectral lines, 12:38054 (R;US)
**Soft X Radiation**
Simultaneous SMM flat-crystal spectrometer and Very Large Array observations of solar-active regions, 12:38056 (R;US)
Solar-active region physical parameters inferred from a thermal cyclotron line and soft-x-ray spectral lines, 12:38054 (R;US)
VLA (Very Large Array) observations of a solar-noise storm, 12:38055 (R;US)
**Solar Neutrons**
High-energy neutral radiations from the sun, 12:38051 (R;US)

**SOLAR AIR CONDITIONERS**
*See also SOLAR-ASSISTED HEAT PUMPS*
**Desiccants**
Performance of a solar desiccant cooling system, 12:36697 (BA;US)
**Design**
Performance of a solar desiccant cooling system, 12:36697 (BA;US)
**Operation**
Performance of a solar desiccant cooling system, 12:36697 (BA;US)
**Thermodynamics**
Performance of a solar desiccant cooling system, 12:36697 (BA;US)

**SOLAR ALPHA PARTICLES**
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)

**SOLAR BATTERIES**
*See SOLAR CELL ARRAYS*

**SOLAR CELL ARRAYS**
**Design**
Concentration principle applied to spaceborne solar arrays. AGORA mission: studies synthesis, 12:36637 (R;FR)
**Solar Tracking Systems**
Modular array field designs for tracking flat-plate photovoltaic systems: Volume 1, 12:36647 (R;US)

**SOLAR CELL RECEIVERS**
*See SOLAR RECEIVERS*

**SOLAR CELLS**
*See also COPPER SULFIDE SOLAR CELLS*
*GALLIUM ARSENIDE SOLAR CELLS*
*SILICON SOLAR CELLS*
**Design**
Floating emitter solar cell, 12:36641 (P;US)
**Organometallic Compounds**
Synthesis of organometallic compounds: Final technical report, 12:37336 (R;US)
**P-N Junctions**
Floating emitter solar cell, 12:36641 (P;US)
**Semiconductor Materials**
Floating emitter solar cell, 12:36641 (P;US)

**SOLAR COLLECTORS**
*See also EVACUATED COLLECTORS*
*FLAT PLATE COLLECTORS*
*SOLAR PONDS*
**District Heating**
Conditions for solar district heating. Market analysis, 12:36680 (R;SE;In Swedish)
**Flow Models**
On the selection of distributed parameter models for control studies of solar energy systems, 12:36717 (BA;US)
**Glazing**
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Heat Transfer**
On the selection of distributed parameter models for control studies of solar energy systems, 12:36717 (BA;US)
**Thermodynamics**
On the selection of distributed parameter models for control studies of solar energy systems, 12:36717 (BA;US)

**SOLAR CONCENTRATORS**
*See also COMPOUND PARABOLIC CONCENTRATORS*
*LUMINESCENT CONCENTRATORS*
*SOLAR REFLECTORS*
**Optics**
Solar power absorption in a glass tube, 12:36704 (R;US)

**SOLAR COOLING SYSTEMS**
*See also SOLAR AIR CONDITIONERS*
*SOLAR REFRIGERATORS*
**Desiccants**
Analysis of the seasonal performance of hybrid desiccant cooling systems, 12:36681 (R;US)
**Evacuated Collectors**
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Performance**
Analysis of the seasonal performance of hybrid desiccant cooling systems, 12:36681 (R;US)

**SOLAR CORONA**
**Iron Ions**
Procedures for reduction of Fe XII 10747 A coronal emission-line polarization observations. Technical note, 12:38064 (R;US)

**SOLAR ENERGY**
Quarterly status of Department of Energy Projects, 12:36971 (R;US)
**Coordinated Research Programs**
Solar energy: European research and development. Contractors' catalogue 1984, 12:36619 (R;XE)
**Energy Source Development**
Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**Research Programs**
Interagency advanced power group project briefs by field of interest and a subject index: Semiannual Compilation, February 1987, 12:37000 (R;US)
Overview: U.S. Department of Energy solar buildings technology program, 12:36698 (BA;US)
**SOLAR ENERGY CONVERSION**
Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, October 1, 1985-October 31, 1986, 12:36578 (R;US)
**SOLAR FLARES**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**Statistical Data**
Statistical aspects of solar flares, 12:38062 (R;US)
**SOLAR FURNACES**
**Performance Testing**
High-temperature solar kilns for brickmaking - a contribution towards thermodynamic design of a system for the utilization of solar process heat, 12:36686 (R;DE;In German)
**Simulation**
High-temperature solar kilns for brickmaking - a contribution towards thermodynamic design of a system for the utilization of solar process heat, 12:36686 (R;DE;In German)
**SOLAR HEAT ENGINES**
Liquid metal thermal electric converter, 12:36657 (R;US)
**SOLAR HEATING SYSTEMS**
*See also PASSIVE SOLAR HEATING SYSTEMS*
*SOLAR-ASSISTED HEAT PUMPS*
**Evacuated Collectors**
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Materials**
Evaluation of materials by the energy yield of an active system, 12:36684 (R;US)
**Testing**
The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
**Thermal Energy Storage Equipment**
Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank, 12:36689 (BA;US)
**SOLAR NEUTRINOS**
*Prior to July, 1975 information was indexed to NEUTRINOS.*
**Radiation Flux**
Resonant neutrino oscillations, 12:38193 (RA;US)
**SOLAR NEUTRONS**
**Detection**
High-energy neutral radiations from the sun, 12:38051 (R;US)
**SOLAR ONE POWER PLANT**
*See BARSTOW SOLAR PILOT PLANT*
**SOLAR PONDS**
**Convection**
Microconvection effects at gradient zone boundaries, 12:36701 (R;US)
**Heat Transfer Fluids**
Laboratory tests of cleaning techniques for immiscible solar ponds, 12:36714 (BA;US)
**Purification**
Laboratory tests of cleaning techniques for immiscible solar ponds, 12:36714 (BA;US)
**SOLAR PROCESS HEAT**
**Parabolic Trough Collectors**
The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
**Solar Heating Systems**
The BDM Corporation modular industrial solar retrofit qualification test results, 12:36687 (R;US)
**SOLAR PROMINENCES**
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**SOLAR PROTON EVENTS**
*See SOLAR PROTONS*
**SOLAR PROTONS**
*Prior to July, 1975 information was indexed to PROTONS.*
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
**SOLAR RADIATION**
**Radiowave Radiation**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
**X Radiation**
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**SOLAR RADIO BURSTS**
Solar-Geophysical Data Number 510, February 1987. Part 2 (comprehensive reports). Data for August 1986, 12:38066 (R;US)
Solar-Geophysical Data Number 511, March 1987. Part 2 (comprehensive reports). Data for September 1986, and miscellanea, 12:38068 (R;US)
**SOLAR RECEIVERS**
*See also CAVITY RECEIVERS*
*CENTRAL RECEIVERS*
**Heat Pipes**
Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)
**Heat Transfer Fluids**
Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
**Performance**
Reflux heat-pipe solar receiver for a Stirling dish-electric system, 12:36658 (R;US)
**Solar Absorbers**
Design and fabrication of absorber panels for a 5-MWt molten salt test solar receiver, 12:36664 (BA;US)
**Surface Coating**
Evaluation of cermet selective absorber coatings deposited by vacuum sputtering: Final subcontract report, 12:36706 (R;US)
**SOLAR REFLECTORS**
*See also PARABOLIC REFLECTORS*
**Adhesion**
Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
**Computer Calculations**
Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
Stress analysis of spherically curved triangular solar panels, 12:36719 (BA;US)
**Fabrication**
Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
Stress analysis of spherically curved triangular solar panels, 12:36719 (BA;US)

**Spherical Configuration**
Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
Stress analysis of spherically curved triangular solar panels, 12:36719 (BA;US)
**Stress Analysis**
Nondimensional parametric stress analysis of spherically curved rectangular solar panels, 12:36720 (BA;US)
Stress analysis of spherically curved triangular solar panels, 12:36719 (BA;US)

**SOLAR REFRIGERATORS**
**Absorption Refrigeration Cycle**
Dynamic performance of absorption systems for control simulation, 12:36700 (BA;US)
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Flow Models**
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Mathematical Models**
Dynamic performance of absorption systems for control simulation, 12:36700 (BA;US)
**Performance**
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Solar Collectors**
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Thermal Efficiency**
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)
**Thermodynamics**
Dynamic performance of absorption systems for control simulation, 12:36700 (BA;US)
Two-dimensional, analysis and performance of a natural convection glazed collector/regenerator, 12:36699 (BA;US)

**SOLAR SEA POWER PLANTS**
*See OCEAN THERMAL POWER PLANTS*

**SOLAR SYSTEM EVOLUTION**
*See also PLANETARY EVOLUTION*
The early solar system abundance of $^{244}$Pu as inferred from the St. Severin chondrite, 12:38070 (R;US)

**SOLAR THERMAL POWER PLANTS**
*See also DISTRIBUTED COLLECTOR POWER PLANTS*
*TOWER FOCUS POWER PLANTS*
**Central Receivers**
Analysis of solar thermal concepts for electricity generation, 12:36672 (BA;US)
Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Computerized Simulation**
Three freeze protection methods applied to a large solar energy system, 12:36671 (BA;US)
**Corrosion**
System selection and life testing results of drain down and glycol closed loop active systems, 12:36660 (BA;US)
**Flat Plate Collectors**
Three freeze protection methods applied to a large solar energy system, 12:36671 (BA;US)
**Freeze Protection**
Three freeze protection methods applied to a large solar energy system, 12:36671 (BA;US)
**Heat Exchangers**
Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Heat Transfer**
Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Parabolic Dish Collectors**
Analysis of solar thermal concepts for electricity generation, 12:36672 (BA;US)
**Parabolic Trough Collectors**
Analysis of solar thermal concepts for electricity generation, 12:36672 (BA;US)
Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Performance**
Analysis of solar thermal concepts for electricity generation, 12:36672 (BA;US)
**Pilot Plants**
Vignola project, 12:36654 (R;FR;In French)
**Pipes**
Performance issues in solar thermal energy transport systems, 12:36655 (R;US)
**T Codes**
Three freeze protection methods applied to a large solar energy system, 12:36671 (BA;US)
**Thermal Efficiency**
Performance issues in solar thermal energy transport systems, 12:36675 (BA;US)
**Thermal Insulation**
Effects of low velocity air flow over alumina-silica insulating boards in solar environments, 12:36673 (BA;US)

**SOLAR THERMAL RECEIVERS**
*See SOLAR RECEIVERS*

**SOLAR WATER HEATERS**
**Design**
A design method for thermosyphon solar domestic hot water systems, 12:36688 (J;US)
Development of an innovative, low-cost solar collector: Final technical report, 12:36685 (R;US)
**Evacuated Collectors**
Data collection and performance reporting specifications for solar energy projects: A report of Task VI: The performance of solar heating, cooling, and hot water systems using evacuated collectors, 12:36683 (R;FR)
**Heat Exchangers**
Comparison of analytical and experimental immersed, collector-side heat exchanger results, 12:36693 (BA;US)
**Materials**
Evaluation of materials by the energy yield of an active system, 12:36684 (R;US)
**Performance**
A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing, 12:36682 (R;US)
**Pipes**
Effects of exposure testing on pipe insulation, 12:36692 (BA;US)
**Stratification**
A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing, 12:36682 (R;US)
**Testing**
A modification of the anti $\theta$,f-chart method for solar domestic water heating systems with no mixing, 12:36682 (R;US)
**Thermal Energy Storage Equipment**
Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank, 12:36689 (BA;US)
**Thermosyphons**
A design method for thermosyphon solar domestic hot water systems, 12:36688 (J;US)

**SOLAR-ASSISTED HEAT PUMPS**
**Metering**
Flow measurement techniques in the evaluation of heat pump and fan performance, 12:36696 (BA;US)
**Performance**
Flow measurement techniques in the evaluation of heat pump and fan performance, 12:36696 (BA;US)
**Thermal Efficiency**
Flow measurement techniques in the evaluation of heat pump and fan performance, 12:36696 (BA;US)

**SOLID STATE LASERS**
**Design**
High average power solid state laser developments at the Lawrence Livermore National Laboratory, 12:37487 (R;US)
**Technology Assessment**
High average power solid state laser developments at the Lawrence Livermore National Laboratory, 12:37487 (R;US)

**SOLID STATE PHYSICS**
Coherence and many-body phenomena. Technical report (Final), 15 August 1984-14 August 1986, 12:38294 (R;US)

**Angular Momentum**
Angular-momentum theory applied to interactions in solids. Summary progress report, 12:38293 (R;US)
**Impurities**
Angular-momentum theory applied to interactions in solids. Summary progress report, 12:38293 (R;US)
**Mathematical Models**
Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986, 12:38297 (R;US)

**SOLID WASTES**
*See also MINERAL WASTES*
*TAILINGS*
*WOOD WASTES*
**Gasification**
Gasification of waste as fuel, 12:37705 (R;SE;In Swedish)
**Pyrolysis**
Production and characterization of pyrolysis liquids from municipal solid waste, 12:37855 (R;US)

**SOLIDS**
**Nondestructive Testing**
Development and applications of NMR [nuclear magnetic resonance] in low fields and zero field, 12:37506 (R;US)
**Pressure Effects**
X-ray spectroscopy of solids under pressure: Technical progress report, July 1984-April 1987, 12:37335 (R;US)
**Rayleigh-Taylor Instability**
An analytical model for Rayleigh-Taylor instability in solids, 12:38301 (R;US)
**Vitrification**
Design of saltstone vaults (Radioactive), 12:36512 (R;US)

**SOLID-STATE PLASMA**
**Dielectric Properties**
Dielectric susceptibility of classical Coulomb systems. II, 12:38304 (J;US)

**SOLVENT-REFINING COAL PLANTS**
*See COAL PREPARATION PLANTS*

**SOLVENTS**
*See also ORGANIC SOLVENTS*
**Indoor Air Pollution**
Health-hazard evaluation report HETA 86-339-1741, EMCO High Voltage Company, Sutter Creek, California, 12:37628 (R;US)

**SONDES**
*See PROBES*

**SOOT**
**Measuring Methods**
Rapid method for determining soot content of lungs in diesel-exposed rodents, 12:37966 (RA;US)
**Pollution Control Equipment**
Instrument for the quasi-continuous determination of the atmospheric soot content, 12:37525 (R;DE;In German)
**Toxicity**
Rapid method for determining soot content of lungs in diesel-exposed rodents, 12:37966 (RA;US)

**SORGHUM**
**Plant Growth**
Herbaceous Energy Corps Program: Annual progress report for FY 1986, 12:36632 (R;US)

**SOURCE ROCKS**
**Permeability**
Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs, 12:36446 (BA;US)
**Porosity**
Source rock evaluation: A method of predicting dominant reservoir mechanisms of deeply buried, low-permeability coal reservoirs, 12:36446 (BA;US)

**SOURCE TERMS**
**S Codes**
STCP validation, 12:36909 (RA;US)

**SOUTH AFRICA**
**Research Programs**
National Register of research projects: Part 1, Natural sciences: Biological, medical and related sciences, 12:38397 (R;ZA;In Afrikaans and English)

**SOVIET UNION**
*See USSR*

**SOY OIL**
*See SOYBEAN OIL*

**SOYBEAN OIL**
**Chemical Preparation**
Stability and composition of palm, coconut and soy oil fatty acid microemulsion diesel fuels, 12:36605 (BA;US)

**SPACE HEATERS**
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)

**SPACE HEATING**
*See also GEOTHERMAL SPACE HEATING*
**Energy Efficiency**
Heating cost allocation in centrally heated rental housing: energy conservation potential and standards issues, 12:37042 (RA;US)
Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings, 12:37049 (RA;US)

**SPACE HVAC SYSTEMS**
*Heating, ventilation, and air conditioning systems.*
**Air Quality**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)
**Cooling Load**
Undoing uncomfortable summer heat islands can save gigawatts of peak power, 12:37029 (RA;US)
**Energy Consumption**
Heat pump in a block of flats with warm air heating, 12:37095 (R;FI;In Finnish)
**Energy Efficiency**
Conversion from central to apartment-level heating in multifamily buildings: the Asbury Park Village case study, 12:37035 (RA;US)
Measured energy savings from vent dampers in low rise apartment buildings, 12:37041 (RA;US)
**Thermal Comfort**
Impact of electric space-heating on comfort of living. Literature study, 12:37071 (R;FI;In Finnish)

**SPACE LATTICES**
*See CRYSTAL LATTICES*

**SPACE POWER REACTORS**
**Fuel Cans**
Performance of refractory alloy-clad fuel pins, 12:36788 (R;US)
**Fuel Pins**
Performance of refractory alloy-clad fuel pins, 12:36788 (R;US)
**Mass**
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)
**Power Distribution**
Considerations pertinent to the Doppler effect for space reactors, 12:36785 (R;US)
**Reactor Kinetics**
Considerations pertinent to the Doppler effect for space reactors, 12:36785 (R;US)
**Shields**
RSMASS: A simple model for estimating reactor and shield masses, 12:36789 (R;US)

**SPACE REFLECTION**
*See P INVARIANCE*

**SPACE VEHICLES**
**Military Equipment**
Safeguarding our military space systems, 12:37190 (J;US)

**SPACE WEAPONS**
**Arms Control**
Safeguarding our military space systems, 12:37190 (J;US)

**SPACECRAFT POWER SUPPLIES**
**Energy Storage**
Assessment of energy storage concepts for use in pulsed space power systems, 12:36786 (R;US)
**Fuel Cells**
Monolithic fuel cells, 12:37010 (R;US)

**Historical Aspects**
Atomic power in space: A history, 12:36787 (R;US)
**SNAP Batteries**
Atomic power in space: A history, 12:36787 (R;US)
**SPARK IGNITION ENGINES**
*See also WANKEL ENGINES*
**Performance**
Studies on engine output control for internal combustion engines, 12:37165 (R;DE;In German)
**Reviews**
Automobile engines. Design and function, 12:37163 (R;DE;In German)
**SPECIAL RELATIVITY THEORY**
*See RELATIVITY THEORY*
**SPECTROCHEMISTRY**
*See EMISSION SPECTROSCOPY*
**SPECTROMETERS**
*See also BETA SPECTROMETERS*
*GAMMA SPECTROMETERS*
*MASS SPECTROMETERS*
*X-RAY SPECTROMETERS*
**Calibration**
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
**Design**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
Feasibility of field detection and analysis of the toxic products of combustion, 12:37957 (R;US)
**Performance Testing**
Application of atomic absorption to on-stream monitoring of molecules and atoms in gas streams, 12:36308 (RA;US)
Design and calibration of Morgantown Energy Technology Center's alkali fiber optic spectrometer, 12:36309 (RA;US)
**SPENT FUEL CASKS**
**Remote Handling**
Robotic handling of spent fuel shipping casks: Preliminary assessment of cask design impacts and technology development needs, 12:37461 (R;US)
**Shielding**
Shielding methods for evaluating the versatility of proposed shipping casks, 12:37453 (R;US)
**SPENT FUEL ELEMENTS**
**Compacting**
Rod consolidation of RG and E's [Rochester Gas and Electric Corporation] spent PWR [pressurized water reactor] fuel, 12:36493 (R;US)
**Dry Storage**
Recommended temperature limits for dry storage of spent light water reactor Zircaloy-clad fuel rods in inert gas, 12:36494 (R;US)
**SPENT FUEL STORAGE**
*See also DRY STORAGE*
**Fission Product Release**
Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
**Leaching**
Results from Cycles 1 and 2 of NNWSI Series 2 spent fuel dissolution tests, 12:36516 (R;US)
**SPENT FUELS**
**Radioactive Waste Disposal**
Area Recommendation Report for the Crystalline Repository Project: Volume 1, Draft, 12:36504 (R;US)
Area Recommendation Report for the Crystalline Repository Project: Volume 2, Plates: Draft, 12:36505 (R;US)
Spent fuel performance in geologic repository environments, 12:36530 (R;US)
**SPICES**
**Chemical Radiation Effects**
Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 2, 12:37899 (R;DE;In German)
Treatment of spices with ionizing radiation - chemical, organoleptical, microbiological and toxicological analyses. Pt. 1, 12:37898 (R;DE;In German)
**SPICULES**
*See SOLAR PROMINENCES*
**SPIN ORIENTATION**
*For the process and condition in quantum physics only; see also POLARIZATION.*
**Measuring Instruments**
Measurement of electron beam polarization at the SLC, 12:37564 (R;US)
**SPINE**
*See VERTEBRAE*
**SPINELS**
**Shock Waves**
Shock-modified transition metal ferrites, 12:37348 (R;US)
**SPIN-OFF**
*See TECHNOLOGY TRANSFER*
**SPRUCES**
**Biological Stress**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Intervention detection - a systematic technique for examining shifts in radial growth rates of forest trees, 12:37858 (RA;US)
**Harvesting**
Tree-ring reconstruction of Indian-Cree tree harvesting in the area, Quebec, Poste-de-la-Baleine, 12:38029 (RA;US)
**Mortality**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Pathological Changes**
Mathematical and statistical evaluations of needle analyses, 12:37941 (RA;DE;In German)
**Plant Growth**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Characterization of historical growth patterns in declining red spruce trees, 12:37805 (RA;US)
Intervention detection - a systematic technique for examining shifts in radial growth rates of forest trees, 12:37858 (RA;US)
Red spruce diameter growth and Weibull functions for even-aged stand development, 12:37735 (RA;US)
Red spruce tree-ring density and growth decline, 12:37753 (RA;US)
Tree-growth, ARMA modelling and pollution, 12:37955 (RA;US)
**Population Density**
Red spruce diameter growth and Weibull functions for even-aged stand development, 12:37735 (RA;US)
**Population Dynamics**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**SPUTTERING**
Multiphoton ionization followed by time-of-flight mass spectroscopy of sputtered neutrals, 12:38296 (R;US)
**STABLE ISOTOPES**
*For specific terms, consult the Appendix.*
*See also BERYLLIUM 9*
*CARBON 12*
*CARBON 13*
*COPPER 63*
*DEUTERIUM*
*GADOLINIUM 154*
*GERMANIUM 76*
*LEAD 208*
*LITHIUM 7*
*OSMIUM 190*
*OSMIUM 192*
*OXYGEN 18*
*RHENIUM 187*
*SELENIUM 82*
*YTTRIUM 89*
**Mass Spectroscopy**
Present and future prospects of accelerator mass spectrometry, 12:37370 (R;US)

**STAINLESS STEEL-304**
**Gas Tungsten-Arc Welding**
Minor element effects on gas tungsten-arc weld penetration, 12:37235 (RA;US)
Origin of trace element effects on GTA weld pool shape, 12:37234 (RA;US)
**Welding**
Effects of minor elements on the welding characteristics of stainless steel, 12:37236 (RA;US)
**STAINLESS STEEL-304L**
**Resistance Welding**
Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
**STAINLESS STEEL-310**
**Corrosion Protection**
Corrosion resistance of chromium carbide coatings in oxygen-sulfur environments, 12:37209 (R;US)
**STAINLESS STEEL-316**
**Additives**
The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)
**Heat Treatments**
The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)
**Mechanical Properties**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
The strengthening mechanisms in modified AISI 316 stainless steels, 12:37231 (R;US)
**Modifications**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
**Welding**
Effects of minor elements on the welding characteristics of stainless steel, 12:37236 (RA;US)
**STAINLESS STEEL-316L**
**Gas Tungsten-Arc Welding**
Minor element effects on gas tungsten-arc weld penetration, 12:37235 (RA;US)
**STAINLESS STEELS**
*STAINLESS STEEL-304*
*See also STAINLESS STEEL-304L*
*STAINLESS STEEL-310*
*STAINLESS STEEL-316*
*STAINLESS STEEL-316L*
**Corrosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Crack Propagation**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Creep**
Application of analytical electron microscopy to design of creep resistant advanced austenitic stainless steels, 12:37210 (R;US)
Creep of austenitic stainless steels at room temperature, 12:37256 (TG;US)
**Erosion**
An assessment of performance of materials for FBC [fluidized-bed combustion] air heater applications, 12:37208 (R;US)
**Helium Embrittlement**
The migration and coalescence of tritium-induced helium bubbles during creep in nickel, 12:38388 (J;US)
**Hot Working**
Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Pipes**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36801 (R;US)
**Residual Stresses**
FEA predictions of residual stress in stainless steel compared to neutron and x-ray diffraction measurements (Finite element analysis), 12:37244 (R;US)
**Resistance Welding**
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**Rolling**
Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Stress Corrosion**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Ultrasonic Testing**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Welding**
Investigations at the Welding Institute, 12:37237 (RA;US)
**STANDARD ELECTROWEAK MODEL**
*See WEINBERG-SALAM GAUGE MODEL*
**STANDARD MODEL**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
The standard model and colliders, 12:38218 (R;US)
**Reviews**
Overview of the standard model, 12:38196 (R;US)
**Testing**
CP and other experimental probes of electroweak phenomena, 12:38127 (RA;US)
**STANDING CROP**
*See BIOMASS*
**STANFORD LINEAR ACCELERATOR CENTER**
**Design**
SLAC site design aesthetics, 12:37534 (BA;US)
**Radiation Protection**
SLAC site design aesthetics, 12:37534 (BA;US)
**STANFORD LINEAR COLLIDER**
**Beam Extraction**
Status report on the Mark II Energy Measurement System, 12:37551 (RA;US)
**Beam Monitoring**
Beam trajectory acquisition system for the arcs of the Stanford Linear Collider, 12:37555 (R;US)
Status report on the Mark II Energy Measurement System, 12:37551 (RA;US)
**Beam Monitors**
Beam position measurements at the SLC IP, 12:37552 (RA;US)
**Beam Transport**
Status report on the polarization facility at the SLC, 12:38173 (RA;US)
**Computerized Control Systems**
Feedback systems in the SLC, 12:37556 (R;US)
**Experiment Planning**
Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)
**Kicker Magnets**
Some fast beam kicker magnet systems at SLAC, 12:37554 (R;US)
**Shower Counters**
Granlibakken report on the SSP Trigger, 12:37550 (RA;US)
**STAR CLUSTERS**
**Cosmic X-Ray Sources**
EXOSAT observations of double-peaked bursts with radius expansion from 4U/MXB 1820-30, 12:38073 (J;US)
**STARS**
*See also NEUTRON STARS*
**Convection**
New estimate of the mixing length and convective overshooting in massive stars, 12:38076 (J;US)
**START-UP (REACTOR)**
*See REACTOR START-UP*
**STATE BUILDINGS**
*See PUBLIC BUILDINGS*
**STATE DIAGRAMS**
*See PHASE DIAGRAMS*
**STATIONARY POLLUTANT SOURCES**
*Used for general articles when sources are not named. See also specific stationary sources, e.g., Fossil-fuel Power Plants.*
**Air Pollution Monitors**
Development of audit devices and materials for source-level air=pollution-measurement methods, 12:37651 (R;US)

**STATORS**
**Electrical Insulation**
Improved motors for utility applications: Volume 5, Motor-winding impulse capability: Final report, 12:36754 (R;US)
**STEAM**
**Chemical Reaction Kinetics**
Effect of pore structure on the char-steam reaction, 12:36287 (B;US)
**STEAM CONDENSERS**
*See also ICE CONDENSERS*
**Maintenance**
Recommended practices for operating and maintaining steam surface condensers: Final report, 12:36752 (R;US)
**Operation**
Recommended practices for operating and maintaining steam surface condensers: Final report, 12:36752 (R;US)
**STEAM COOLANT**
*See STEAM*
**STEAM GENERATORS**
**Energy Consumption**
A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)
**Statistics**
A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)
**STEAM INJECTION**
**Comparative Evaluations**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**Computerized Simulation**
Supporting technology for enhanced oil recovery: Steamflood predictive model: Annex III, Evaluation of past and ongoing enhanced oil recovery projects, 12:36376 (R;US)
**Economic Analysis**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**Mathematical Models**
The comparative economics of thermal recovery projects, 12:36382 (R;US)
**STEAM REFORMER PROCESSES**
**Chemical Reactors**
Porosity and pressure drop of a Raschig-ring-bed, 12:36577 (R;DE;In German)
**STEAM SEPARATORS**
**Mathematical Models**
Steam separator modeling for various nuclear reactor accidents, 12:36853 (RA;US)
**STEAM SYSTEMS**
**Materials**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
**Materials Testing**
Procurement and screening test data for advanced austenitic alloys for 650 degrees C steam service (Part 1, 14Cr-16Ni steels and 20Cr-30Ni-Fe alloys), 12:36755 (R;US)
**Temperature Control**
Reducing temperature imbalance in single-pipe steam buildings, 12:37044 (RA;US)
**STEEL INDUSTRY**
*See METAL INDUSTRY*
**STEEL-ASTM-A106**
**Fracture Mechanics**
Pipe-to-pipe impact program, 12:36778 (R;US)
**Pipes**
Pipe-to-pipe impact program, 12:36778 (R;US)
**STEELS**
*See also AUSTENITIC STEELS*
*CARBON STEELS*
*STAINLESS STEELS*
**Casting**
Development of an advanced gas-fired furnace for high-temperature heating of continuously cast thin-section steel products. Final report, January-December 1986, 12:36463 (R;US)
**Cathodic Protection**
Effectiveness of cathodic protection--Phase 4. Final report, October 1984-September 1986, 12:36458 (R;US)
**Fracture Mechanics**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
**Gas Tungsten-Arc Welding**
Minor element effects on gas tungsten-arc weld penetration (AISI 8630), 12:37235 (RA;US)
**Grain Boundaries**
Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel, 12:37261 (J;US)
**Hot Working**
Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Hydrogen Embrittlement**
Auger analysis of hydrogen embrittled grain boundaries in a boron containing AISI 1520 steel, 12:37261 (J;US)
**Impact Strength**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
**Magnetic Properties**
Investigation of the microstructural dependence of the magnetic properties of 4130 alloy steels and carbon steels for NDE, 12:37269 (BA;US)
**Magnetic Testing**
Investigation of the microstructural dependence of the magnetic properties of 4130 alloy steels and carbon steels for NDE, 12:37269 (BA;US)
**Microstructure**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
Investigation of the microstructural dependence of the magnetic properties of 4130 alloy steels and carbon steels for NDE, 12:37269 (BA;US)
**Oxidation**
Oxide scale formation on steel in fuel fired reheating furnaces, 12:37214 (RA;SE)
**Protective Coatings**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Rolling**
Inductive heating - influence on surface standard, microstructure and ductility, 12:37213 (RA;SE)
**Scaling**
Oxide scale formation on steel in fuel fired reheating furnaces, 12:37214 (RA;SE)
Surface quality with oxygen control of furnace atmosphere, 12:37215 (RA;SE)
**Tensile Properties**
Example of the structure of the steel used in manufacture for nuclear power station components, taking welding and heat treatment into special account (5. Technical report. Pt. 2), 12:37202 (R;DE;In German)
**STELLAR ATMOSPHERES**
*Excludes SOLAR ATMOSPHERE.*
**Measuring Methods**
Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986, 12:38050 (R;US)
**STELLARATOR TYPE REACTORS**
**ICR Heating**
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
**Plasma Diagnostics**
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
**STELLARATORS**
*See also HELIAC STELLARATORS*
Linear helical-axis stellarator experiments, 12:38336 (RA;FR)
**MHD Equilibrium**
Method and apparatus for maintaining equilibrium in a helical axis stellarator, 12:38367 (P;US)

**Plasma Instability**
Method and apparatus for maintaining equilibrium in a helical axis stellarator, 12:38367 (P;US)

**STIMULATED EMISSION DEVICES**
*See GASERS*
*LASERS*

**STIRLING ENGINES**
**Control**
Evaluation of power control methods for free-piston Stirling engine driven heat pumps, 12:37025 (R;US)

**STORAGE BATTERIES**
*See ELECTRIC BATTERIES*

**STORAGE FACILITIES**
**Design**
Vault demonstration program, 12:37596 (R;US)
**Fires**
Health-hazard evaluation report HETA 84-484-1754, Detroit Fire Fighters, Detroit, Michigan, 12:37694 (R;US)

**STORAGE RINGS**
*See also ISABELLE STORAGE RINGS*
*SUPERCONDUCTING SUPER COLLIDER*
**Beam Dynamics**
Luminosity of continuous beams with crossing angle, 12:37546 (BA;US)

**STORAGE (SPENT FUEL)**
*See SPENT FUEL STORAGE*

**STORES**
*See COMMERCIAL BUILDINGS*

**STORM WINDOWS**
**Energy Efficiency**
Fuel savings analysis: house doctoring and storm windows, 12:37046 (RA;US)

**STOVER**
*See AGRICULTURAL WASTES*

**STRAND BREAKS**
**Electron Microscopy**
Electron microscopy of single-stranded structures in the DNA of competent Haemophilus influenzae cells, 12:37871 (J;US)

**STRANGE PARTICLES**
*See also F MESONS*
**Hadronic Particle Decay**
New results on mesons containing strange quarks, 12:38140 (RA;US)
**Particle Production**
New results on mesons containing strange quarks, 12:38140 (RA;US)

**STRATEGIC DEFENSE INITIATIVE**
*See BALLISTIC MISSILE DEFENSE*

**STRATEGIC PETROLEUM RESERVE**
**Monitoring**
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**Program Management**
Strategic Petroleum Reserve: Quarterly report, 12:36427 (R;US)

**STREAMER SPARK CHAMBERS**
**Particle Tracks**
Low-light-level video system for data acquisition from optical particle detectors, 12:37565 (R;DE)

**STREAMS**
*See also RIVERS*
**Acidification**
Effects of acidification on stream ecosystems, 12:37843 (R;US)
**Flood Control**
Floods on East Fork Mulberry Creek and Price Branch in the vicinity of Lynchburg, Tennessee, 12:38040 (R;US)
**Flow Models**
Numerical simulation of flow in Brush Creek Valley, Colorado, 12:37728 (R;US)
**Modifications**
Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)
**Width**
Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)

**STREETS**
*See ROADS*

**STRENGTH (COMPRESSION)**
*See COMPRESSION STRENGTH*

**STRING MODELS**
*Treating the interactions of extended particles through breaking and connection of strings.*
**Cosmology**
Cosmic strings in an expanding spacetime, 12:38058 (R;US)
**Geometry**
The superstring, Diff$S^1/S^1$, and holomorphic geometry, 12:38217 (R;US)
**Grand Unified Theory**
Fate of the m/sub b//m/sub tau/ mass relation in superstring theories, 12:38202 (J;NL)
**Lectures**
Introduction to string and superstring theory II, 12:38223 (R;US)
**Renormalization**
Curvature of Super Diff($S^1$)/$S^1$, 12:38216 (R;US)
**Reviews**
Superstring spectroscopy, 12:38222 (RA;US)
**Superconductivity**
Superconducting cosmic strings with massive fermions, 12:38225 (J;NL)
**Supersymmetry**
Double covering of diffeomorphisms for superstrings in generic curved space, 12:38227 (BA;US)
Phenomenological clues for discrete symmetries in superstring theories, 12:38211 (J;US)

**STRONTIUM 86 TARGET**
**Neutron Reactions**
Neutron capture cross sections for $^{86}Sr$ and $^{87}Sr$ at stellar temperatures, 12:38247 (BA;DE)

**STRONTIUM 87 TARGET**
**Neutron Reactions**
Neutron capture cross sections for $^{86}Sr$ and $^{87}Sr$ at stellar temperatures, 12:38247 (BA;DE)

**STRONTIUM 90**
**Body Burden**
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
**Inhalation**
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
**Toxicity**
Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: late biological effects, 12:37910 (RA;US)
Toxicity of $^{90}Sr$ inhaled in a relatively insoluble form by Beagle dogs. XV, 12:37915 (RA;US)
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)

**STRONTIUM CHLORIDES**
**Density**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Free Enthalpy**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)
**Specific Heat**
Thermodynamics of aqueous magnesium chloride, calcium chloride, and strontium chloride at elevated temperatures, 12:37421 (J;US)

**STRONTIUM COMPOUNDS**
*See also STRONTIUM CHLORIDES*
*STRONTIUM OXIDES*
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)

**STRONTIUM OXIDES**
**Band Theory**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Microstructure**
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
**Superconductivity**
Correlations among thermal processing, superconducting properties, and microstructure in La/sub 1.85/Sr/sub 0.15/$CuO_4$, 12:37291 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**Transition Temperature**
Variation of the pressure dependence of the superconducting transition temperature with x in La/sub 1-//sub x/Sr/sub x/$CuO_4$, 12:37305 (J;US)
**STRUCTURAL BEAMS**
**Composite Materials**
Material damping measurements of 2-d carbon-carbon composite beams. Master's thesis, 12:37324 (R;US)
**STRUCTURAL BUCKLING**
*See DEFORMATION*
**STRUCTURAL MATERIALS**
*See BUILDING MATERIALS*
**STRUCTURAL MODELS**
**Compression Strength**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
**Pyrolysis**
Thermolysis of surface-attached 1,3-diphenylpropane: Impact of surface immobilization on thermal reaction mechanisms, 12:36296 (R;US)
**Shear Properties**
A study of the effects of penetration framing on steel containment buckling capacity, 12:36805 (R;US)
**STRUCTURES (BUILDINGS)**
*See BUILDINGS*
**STRUCTURES (MECHANICS)**
*See MECHANICAL STRUCTURES*
**STUDS**
*See FASTENERS*
**SUBBITUMINOUS COAL**
**Chemical Analysis**
New approaches to the characterization of lignites: a combined geological and chemical study, 12:36323 (BA;NL)
**SUBCRITICAL FLOW**
*See LAMINAR FLOW*
**SUBURBS**
*See URBAN AREAS*
**SUDDEN IONOSPHERIC DISTURBANCE**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
**SUGAR INDUSTRY**
**Organic Wastes**
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**SULFATES**
*See also IRON SULFATES*
*POTASSIUM SULFATES*
*SODIUM SULFATES*
**Chemical Analysis**
Identification of gas-phase dimethyl sulfate and monomethyl hydrogen sulfate in the Los Angeles atmosphere, 12:37645 (R;US)
**Deposition**
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
**Particulates**
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)
**Separation Processes**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)
**SULFONATES**
*For salts of sulfonic acids; for esters see SULFONIC ACID ESTERS.*
**Phase Diagrams**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986 (Sodium dodecylbenzene sulfonate, sodium chloride, water, n-decane and n-butane), 12:36378 (R;US)
**SULFONES**
**Fabrication**
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: an initial study, 12:37346 (R;US)
**Mechanical Properties**
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: an initial study, 12:37346 (R;US)
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**Tensile Properties**
Baseline tensile tests of composite materials for LDEF (Long duration exposure facility) exposure, 12:37342 (R;US)
**SULFUR**
**Air Pollution Abatement**
TRW Gravimelt Process for desulfurization and demineralization of coal, 12:36286 (B;US)
**Recovery**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**SULFUR COMPOUNDS**
*See also CARBON OXYSULFIDE*
*SULFATES*
*SULFUR FLUORIDES*
*SULFUR OXIDES*
**Inhalation**
Technique for aerosol deposition restricted to the nose in Beagle dogs, 12:37961 (RA;US)
**Retention**
Technique for aerosol deposition restricted to the nose in Beagle dogs, 12:37961 (RA;US)
**SULFUR DIOXIDE**
**Air Pollution Control**
America's clean coal commitment, 12:36235 (R;US)
Comprehensive report to Congress Clean Coal Technology Program: Enhancing the use of coals by gas reburning and sorbent injection, 12:36326 (R;US)
**Air Pollution Monitoring**
Remote measurement of sulfur dioxide emissions using an ultraviolet-light-sensitive video system, 12:37644 (R;US)
**Biological Effects**
Airway sensitivity of asthmatics to sulfur dioxide, 12:37994 (R;US)
**Corrosive Effects**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Deposition**
Dry deposition of acidic gases and particles. Final report, 12:37667 (R;US)
Dry-deposition measurements of sulfur dioxide to a spruce-fir forest in the Black Forest: a data report. Technical memo, 12:37671 (R;US)
Experimental study of sulfur and NOx fluxes over grassland, 12:37648 (R;US)
**Ecological Concentration**
Dendroecological analysis of ambient sulfur dioxide effects in western larch (Larix occidentalis Nutt.), 12:37947 (RA;US)
**Emission**
Sulfur dioxide emissions from oil refineries and combustion of oil products in western europe (1985), 12:37647 (R;NL)
**Environmental Transport**
Comparison between four different interregional air pollution models. Appendix 1, 12:37598 (R;DE)

**Equilibrium**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**Mixing**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Phase Studies**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**Purification**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Recovery**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Reduction**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**Removal**
Characterization of advanced sorbents for dry $SO_2$ control. Published paper, October 1984-March 1987, 12:36331 (R;US)
Combined SO/sub x//No/sub x/ removal and concentration from flue gas through an electrochemical membrane: Progress report for the period June 1984-January 1987, 12:37606 (R;US)
European activities in $SO_2$ and NOx emission control. Report for April 1986-March 1987, 12:36332 (R;US)
FGD (flue-gas desulfurization), SCR (selective-catalytic-reduction) gain: coal-fired-boiler experience in Japan, 12:36334 (R;US)
NO/sub x/ and $SO_2$ removal from flue gas by ferrous ion-peptide solutions, 12:36330 (R;US)
Properties of CuO sorbents related to $SO_2$ reactivity, 12:36760 (R;US)
**Scrubbers**
Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for September 1985-April 1986, 12:37653 (R;US)
**Sorption**
Calcium-based sorbents in the LIMB (Limestone Injection Multistage Burner) process, 12:37670 (R;US)
Silica-enhanced sorbents for dry-injection removal of $SO_2$ from flue gas. Report for September 1986-March 1987, 12:37669 (R;US)
**Toxicity**
Dendroecological analysis of ambient sulfur dioxide effects in western larch (Larix occidentalis Nutt.), 12:37947 (RA;US)

**SULFUR FLUORIDES**
**Atomic Beam Sources**
Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)

**SULFUR HYDRIDES**
*See HYDROGEN SULFIDES*

**SULFUR OXIDES**
*See also SULFUR DIOXIDE*
*SULFUR TRIOXIDE*
**Health Hazards**
Air-Quality Criteria for Particulate Matter and Sulfur Oxides (1982) (second addendum): assessmet of newly available health-effects information. Final report, 12:37642 (R;US)
**Removal**
Effective mixing processes for SOx, sorbent, and coal-combustion products. Final report, October 1984-July 1986, 12:36765 (R;US)

**SULFUR SULFIDES**
*See SULFUR*

**SULFUR TRIOXIDE**
**Thermochemical Diagrams**
Effect of coal cleaning on the combustion environment-materials interaction, 12:36232 (R;US)

**SULFURIC ACID**
**Corrosive Effects**
Corrosion behavior of phosphorus-implanted Fe-6Cr and Fe-18Cr amorphous alloys, 12:37258 (J;US)
**Separation Processes**
Use of isopropanol to distinguish $H_2SO_4$ from particulate sulfate on filters, 12:37656 (R;US)

**SUNSPOTS**
Solar-Geophysical Data Number 510, February 1987. Part 1 (prompt reports). Data for January 1987, December 1986, and late data, 12:38065 (R;US)
**Statistical Data**
Sunspot numbers: 1610-1985 based on The Sunspot-Activity in the Years 1610-1960', 12:38067 (R;US)

**SUPERALLOYS**
*See HEAT RESISTING ALLOYS*

**SUPERCOMPUTERS**
**Algorithms**
Algorithm implementation on the Navier-Stokes computer, 12:37495 (R;US)
**Computer Calculations**
Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)
**Parallel Processing**
Performance evaluation of parallel branch and bound search with the Intel IPSC (Intel Personal Supercomputer) hypercube computer. Master's thesis, 12:38403 (R;US)
**Uses**
Quantum chemical methods for massively parallel computers, 12:38308 (R;US)

**SUPERCONDUCTING COILS**
Superconducting augmented rail gun (SARG). Final technical report, 12:37528 (R;US)

**SUPERCONDUCTING COMPOSITES**
**Electric Conductivity**
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
**Magnetic Susceptibility**
Investigation of heavy fermion and dense Kondo systems in Ce-based ternary silicides, 12:37337 (R;US)
**Transition Temperature**
Superconductivity, magnetism, and charge density wave formation in ternary compounds with the $Sc_5Co_4Si_{10}$-type structure, 12:37338 (R;US)

**SUPERCONDUCTING FILMS**
**Magnetic Shielding**
Annihilation of vortex-antivortex pairs in a superconducting shield, 12:37458 (R;US)

**SUPERCONDUCTING JUNCTIONS**
*See also JOSEPHSON JUNCTIONS*
**Energy Beam Deposition**
Superconducting thin films, composites & junctions. Annual report, 1 October 1985-30 September 1986, 12:37450 (R;US)
**Tunnel Effect**
SIS (superconductor-insulator-superconductor) mixer research. Final report, 15 November 1985-14 November 1986, 12:37452 (R;US)

**SUPERCONDUCTING SUPER COLLIDER**
**Site Selection**
Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: results of the Fall 1984 test-drilling program. Environmental geology notes, 12:37562 (R;US)

**SUPERCONDUCTING WIRES**
**Current Density**
Importance of spacing in the development of high current densities in multifilamentary superconductors, 12:37255 (J;GB)

**SUPERCONDUCTIVITY**
Heavy electron superconductivity: From 1K to 90K to ?, 12:38306 (R;US)

**SUPERCONDUCTORS**
**Impurities**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**Low Temperature**
Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)
**Magnetic Properties**
Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)

**Physical Radiation Effects**
The influence of N-ion irradiation on superconducting TiN, 12:37212 (R;US)
**Thin Films**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
**SUPERCRITICAL FLOW**
*See TURBULENT FLOW*
**SUPERFUND**
Soil-gas measurement for detection of subsurface organic contamination, 12:37810 (R;US)
**Manuals**
Superfund public health evaluation manual, 12:37892 (R;US)
**Program Management**
Superfund innovative technology evaluation (site) strategy and program plan, 12:37811 (R;US)
**Remedial Action**
Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
**Technology Utilization**
Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment), 12:36973 (R;US)
**Waste Processing**
Superfund treatment technologies: a vendor inventory, 12:37814 (R;US)
**SUPERLATTICES**
**Neutron Diffraction**
Artific al magnetic superlattices, 12:38295 (R;US)
**SUPERNOVAE**
Supernovae and high density nuclear matter, 12:38285 (BA;DE)
**Measuring Methods**
Program of ground-based astronomy to complement Einstein observations. Final report, 1 October 1981-30 September 1986, 12:38050 (R;US)
**SUPERSYMMETRY**
**String Models**
Fate of the m/sub b//m/sub tau/ mass relation in superstring theories, 12:38202 (J;NL)
**Testing**
Ir(t-arrow-right,$\alpha$)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)
**SUPERVOLTAGE RADIOTHERAPY**
*See RADIOTHERAPY*
**SUPPLY AND DEMAND**
**R Codes**
Documentation of the resource allocation and mine costing (RAMC) model: Methodology description, 12:36984 (R;US)
**SUPPORTS**
**Design**
Support assembly having three dimension position adjustment capabilities, 12:37471 (P;US)
**SUPPORTS (CATALYST)**
*See CATALYST SUPPORTS*
**SURFACE MINING**
**Explosive Fracturing**
Effects of accurate MS delays on productivity, energy consumption at the primary crusher, oversize, ground vibrations and airblast, 12:36346 (BA;US)
**Hydrology**
Hydrologic models of surface-mined areas. Technical report, 12:36341 (R;US)
**Land Reclamation**
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**Runoff**
Hydrologic models of surface-mined areas. Technical report, 12:36341 (R;US)
**SURFACE WATERS**
*See also ESTUARIES*
*LAKES*
*STREAMS*
*WATER RESERVOIRS*
**Acidification**
The role of dry deposition in acidification of waters, 12:37767 (R;US)
**SURFACE-ACTIVE AGENTS**
*See SURFACTANTS*
**SURFACTANTS**
Dispergents influence on evaporation and dissolution of oil on seawater, 12:36419 (R;NO;In Norwegian)
**Adsorption**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**Bench-Scale Experiments**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**Phase Studies**
Model surfactant studies 1: preliminary investigations of phase behaviour, 12:36368 (R;GB)
**Testing**
Effectiveness of oil dispersants laboratory experiments, 12:36421 (R;NO)
**SURRY POWER STATION UNIT-1**
*See SURRY-1 REACTOR*
**SURRY POWER STATION UNIT-2**
*See SURRY-2 REACTOR*
**SURRY-1 REACTOR**
*Gravel Neck, Virginia, USA*
**Reactor Core Disruption**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**SURRY-2 REACTOR**
*Gravel Neck, Virginia, USA*
**Reactor Core Disruption**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**SURRY-3 REACTOR**
*Gravel Neck, Virginia, USA*
**Reactor Core Disruption**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**SURRY-4 REACTOR**
*Gravel neck, Virginia, USA*
**Reactor Core Disruption**
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**Reactor Safety**
Development and applications of the interim direct heating model for the CONTAIN computer code, 12:36912 (RA;US)
MELPROG/TRAC: update and applications, 12:36907 (RA;US)
**SURVEILLANCE**
**Alarm Systems**
The Livermore Security Console system, 12:36572 (R;US)
**Robots**
SIR-1: An autonomous mobile sentry robot, 12:36570 (R;US)
**SUSPENSIONS**
**Heat Transfer**
Conduction of heat from a planar wall with uniform surface temperature to a monodispersed suspension of spheres, 12:37503 (J;US)
**SUSPENSIONS (FUEL)**
*See FUEL SLURRIES*

**SWEDEN**
**Energy Conservation**
Umea energy savings blocks quality controlled programs save up to 40% energy in houses built in the 70's, 12:37043 (RA;US)
**Energy Policy**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**Energy Supplies**
Municipal responses to the energy challenge: Gothenburg and Uppsala, Sweden, 12:36951 (R;DE)
**SWEET GUMS**
*Liquidambar styraciflua.*
**Biological Stress**
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
**Plant Growth**
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
**SWINE**
**Biological Stress**
Study investigating the impact of aircraft noise on physiological, endocrinological and ethological criteria with regard to pregnant sows, roaming free or kept in barns, 12:38014 (R;DE;In German)
**SWITZERLAND**
**Climates**
Heating days in Switzerland. Recommendation. Version 1982, 12:37724 (R;DE;In German)
**SYCAMORES**
**Plant Growth**
Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)
**SYMMETRY**
*See also SUPERSYMMETRY*
**Reviews**
Mysterious world of symmetry in physics, 12:38315 (BA;US)
**SYNCHROPHASOTRONS**
*See SYNCHROTRONS*
**SYNCHROTRON RADIATION**
**Pressure Dependence**
Plasma current sustained by fusion charged particles in a field reversed configuration, 12:38331 (R;US)
**Uses**
The application of a synchrotron radiation microprobe to trace element analysis, 12:37873 (R;US)
**SYNCHROTRON RADIATION SOURCES**
**Design**
Tunable coherent x-rays, 12:37559 (J;US)
**Magnetic Field Configurations**
The magnet lattice of the LBL 1-2 GeV Synchrotron Radiation Source, 12:37561 (R;US)
**Optimization**
ZAP and its application to the optimization of synchrotron light source parameters, 12:37560 (R;US)
**Performance**
Tunable coherent x-rays, 12:37559 (J;US)
**Z Codes**
ZAP and its application to the optimization of synchrotron light source parameters, 12:37560 (R;US)
**SYNCHROTRONS**
*See also BROOKHAVEN AGS*
*FERMILAB TEVATRON*
**Design**
Accelerator facilities in the 100-1000 TeV range, 12:37537 (BA;US)
**Performance**
Conventional 20-TeV, 10-Tesla, p/sup +-/p colliders, 12:37536 (BA;US)
**Planning**
1 teV on 1 teV pp/p-barp dedicated collider at Fermilab using energy saver components, 12:37538 (BA;US)
Accelerator facilities in the 100-1000 TeV range, 12:37537 (BA;US)
Conventional 20-TeV, 10-Tesla, p/sup +-/p colliders, 12:37536 (BA;US)
**Reviews**
The future of electron-positron colliders, 12:37535 (BA;US)
**SYNCRUDE**
*See SYNTHETIC PETROLEUM*
**SYNTHESIS GAS**
**Mixing**
Sulfur recovery from hot coal gas desulfurization processes: Final report, 12:36241 (R;US)
**SYNTHETASES**
*See LIGASES*
**SYNTHETIC CRUDE OIL**
*See SYNTHETIC PETROLEUM*
**SYNTHETIC NATURAL GAS**
*See HIGH BTU GAS*
**SYNTHETIC PETROLEUM**
**By-Products**
Exploitation of asphalts by hydrogenation in extreme conditions using introduced catalysts. Final report, 12:36276 (R;XE;In French)
**SYNTHINE PROCESS**
*See FISCHER-TROPSCH SYNTHESIS*
**SYSTEMS ANALYSIS**
*Used in the fields of technology research and management for problems such as the calculation of failure probabilities and for reliability studies of systems and components.*
**Mathematical Models**
Mathematical programming studies of short run oil refinery rents, 12:36410 (R;DE)

## T

**T CODES**
Analytic models of nuclide transport in saturated geologic media, 12:36533 (R;US)
Sandia implementation of the TRACR3D flow and transport code: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:37822 (R;US)
**TAILINGS**
*Solid residue separated in the preparation of various products.*
*See also MILL TAILINGS*
**Environmental Impacts**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**Materials Recovery**
Utilization and stabilization of mineral wastes. Bulletin, 12:37672 (R;US)
**TAIWAN**
**Natural Gas Deposits**
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
**TALC**
**Particle Size**
Evaluation of a two-stage virtual impactor as a monodisperse aerosol classifier, 12:36337 (RA;US)
**TANDEM MIRROR DEVICES**
*See TMR REACTORS*
**TANDEM MIRROR TYPE REACTORS**
*See TMR REACTORS*
**TANK FARMS**
*See STORAGE FACILITIES*
**TANKS**
**Configuration**
Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)
**Installation**
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)

**Mathematical Models**
Energy storage in phase-change materials. Development of a component model compatible with the 'TRNSYS' transient simulation program. Final report, 12:36938 (R;DE)
**Remote Handling Equipment**
The remote installation of a new riser on an existing high level waste (HLW) tank, 12:36546 (BA;US)
**TANTALUM 181 TARGET**
**Lithium 6 Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**TAR**
*See also COAL TAR*
**Calorific Value**
Analysis of medium-BTU gasification condensates, June 1985-June 1986, 12:38006 (R;US)
**Chemical Composition**
Analysis of medium-BTU gasification condensates, June 1985-June 1986, 12:38006 (R;US)
**Mutagenesis**
Analysis of medium-BTU gasification condensates, June 1985-June 1986, 12:38006 (R;US)
**TAR SANDS**
*See OIL SANDS*
**TARA DEVICES**
**ICR Heating**
Modeling of ICRH experiments in the Tara tandem mirror, 12:38327 (R;US)
**Wave Propagation**
Modeling of ICRH experiments in the Tara tandem mirror, 12:38327 (R;US)
**TAU LEPTONS**
*See TAU PARTICLES*
**TAU PARTICLES**
**Leptonic Decay**
Status of Monte Carlos for a tau pair production at SLC, 12:38170 (RA;US)
**Pair Production**
Status of Monte Carlos for a tau pair production at SLC, 12:38170 (RA;US)
**Particle Production**
Physics from PEP, 12:38134 (RA;US)
Recent results from the UA1 experiment at CERN, 12:38131 (RA;US)
Recent results from ARGUS, 12:38136 (RA;US)
**Radiative Decay**
Recent results from the crystal ball experiment, 12:38138 (RA;US)
**Semileptonic Decay**
Evidence for the decay tau$^-$ $\rightarrow \pi^-$ eta nu/sub tau/, 12:38111 (R;US)
Physics from PEP, 12:38134 (RA;US)
Recent results from the crystal ball experiment, 12:38138 (RA;US)
Status of Monte Carlos for a tau pair production at SLC, 12:38170 (RA;US)
**Weak Particle Decay**
The decay tau $\rightarrow$ rho nu (and rho $\rightarrow \pi$ eta nu?), 12:38149 (R;US)
**TAUONS**
*See TAU PARTICLES*
**TAUTOMERISM**
*See ISOMERIZATION*
**TAXICABS**
**Computerized Control Systems**
Alfa Romeo modular taxi: Demonstration project. Final report, 12:37162 (R;FR)
**Energy Conservation**
Alfa Romeo modular taxi: Demonstration project. Final report, 12:37162 (R;FR)
**TBP**
**Solvent Properties**
Vapor-liquid equilibria of sulfur dioxide in polar organic solvents, 12:37411 (J;US)
**TECHNETIUM 99**
**Indoor Air Pollution**
Mortality among uranium enrichment workers, 12:36480 (R;US)
**TECHNOLOGY ASSESSMENT**
Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment), 12:36974 (R;US)
**TECHNOLOGY TRANSFER**
Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment), 12:36974 (R;US)
**TECHNOLOGY UTILIZATION**
Annual report to the Congress, Fiscal Year 1984 (Office of Technology Assessment), 12:36974 (R;US)
**TEFLON**
**Ion Microprobe Analysis**
Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)
**Mass Spectroscopy**
Focused, rasterable, high-energy neutral molecular beam probe for secondary ion mass spectrometry, 12:37384 (J;US)
**TELESCOPES**
**Performance Testing**
Normal incidence x-ray telescope. Semiannual progress report, 1 May 1985-31 October 1986, 12:37566 (R;US)
**TEM (MICROSCOPY)**
*See TRANSMISSION ELECTRON MICROSCOPY*
**TEMPERATURE (AMBIENT)**
*See AMBIENT TEMPERATURE*
**TEMPERATURE CONTROL**
**Comparative Evaluations**
An evaluation of three temperature controllers for a +- 0.002°C application, 12:37467 (R;US)
**Performance Testing**
An evaluation of three temperature controllers for a +- 0.002°C application, 12:37467 (R;US)
**TERTIARY RECOVERY**
*See ENHANCED RECOVERY*
**TEST FACILITIES**
**Research Programs**
Status of integral facilities and future plans for integral testing, 12:36840 (RA;US)
**Scale Models**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**TESTING (BIOLOGICAL)**
*See BIOASSAY*
**TETRACYCLINES**
**Production**
Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
**Purification**
Evaluation of separation and purification processes in the antibiotic industry, 12:37860 (R;US)
**TETRAHYDROFURAN**
**Chemical Reaction Kinetics**
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
**Hydrolysis**
Reactivity of silicates 1. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates, 12:37427 (BA;US)
**TETRATHIAFULVALENE**
*See TTF*
**TEVATRON**
*See FERMILAB TEVATRON*
**TEXAS**
**Background Radiation**
Determination of background radiological characteristics within the Palo Duro Basin, Texas: Technical report, 12:37818 (R;US)
**Natural Gas Deposits**
Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)
Detection/differentiation system development for deep source gases: Final report for Phase 1, October 1984-December 1985, 12:36430 (R;US)
Reliability of laboratory measurement of porosity in tight gas sands, 12:36432 (BA;US)

**Natural Gas Fields**
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
Pressure transient response in multilayer gas reservoirs containing hydraulic fractures, 12:36455 (BA;US)
The analysis of complex Travis Peak reservoirs in east Texas, 12:36441 (BA;US)
**Oil Fields**
Depositional setting and production characteristics of low permeability sandstones, upper Cretaceous Olmos Formation, South Texas, 12:36397 (BA;US)
**Salt Caverns**
Strategic Petroleum Reserve (SPR) long-term monitoring system pressure data analyses, 12:36428 (R;US)
**Water Resources**
Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)

**TEXAS EXPERIMENTAL TOKAMAK**
*See TEXT DEVICES*

**TEXT DEVICES**
**Divertors**
Enhanced particle flux control in a tokamak with a resonant helical divertor, 12:38380 (R;US)

**TEXTILE INDUSTRY**
**Energy Efficiency**
Approach to a more rational use of energy in the textile area of Prato. Diffusion proposals and operative indications of intervention, 12:37141 (R;IT;In Italian)
**Separation Processes**
The use of membranes in hybrid industrial separation systems: Final report, 12:37142 (R;US)

**TFTR DEVICE**
*See TFTR TOKAMAK*

**TFTR REACTORS**
*See TFTR TOKAMAK*

**TFTR TOKAMAK**
**Antennas**
Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)
**Joule Heating**
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)
**Limiters**
Impurity and particle transport and control in TFTR, 12:38382 (R;US)
**Neutral Atom Beam Injection**
Energy confinement and profile consistency in TFTR, 12:38351 (R;US)
**Plasma Confinement**
Energy confinement and profile consistency in TFTR, 12:38351 (R;US)
Impurity and particle transport and control in TFTR, 12:38382 (R;US)
Transport simulations of ohmic TFTR experiments with profile-consistent microinstability-based models for chi/sub e/ and chi/sub i/, 12:38344 (R;US)

**THALLIUM COMPOUNDS**
**Phosphorescence**
External heavy-atom effect in room-temperature phosphorescence, 12:37382 (J;US)

**THERAPEUTIC AGENTS**
*See DRUGS*

**THERMAL CONDUCTIVITY**
**Correlations**
Quantitative microstructural effects on the conductivity of composites, 12:37298 (R;DE;In German)
**Measuring Methods**
Thermal conductivities of ternary liquid mixtures, 12:37420 (J;US)

**THERMAL CYCLING**
**Coatings**
Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)

**THERMAL DECOMPOSITION**
*See PYROLYSIS*

**THERMAL ENERGY STORAGE EQUIPMENT**
Thermal Energy Storage Evaluation Program: 1986 annual report (Economic planning, technical assessment, field tests), 12:36939 (R;US)
**Heat Exchangers**
Heat transfer measurements from a load-side heat exchanger immersed in a stratified storage tank, 12:36689 (BA;US)

**THERMAL ENVELOPE HOUSES**
*See DOUBLE ENVELOPE BUILDINGS*

**THERMAL INSULATION**
**Cost Benefit Analysis**
Superinsulated houses: The importance of resale value, 12:37098 (BA;US)
**Installation**
Retrofit wall insulation study, 12:37039 (RA;US)
**Performance**
Measured performance of superinsulated homes in Montana: second report, 12:37052 (RA;US)
**Performance Testing**
Membranes improve insulation efficiency, 12:37030 (RA;US)
**Retrofitting**
Keeping warm: findings from the Kansas City warm room retrofit project, 12:37058 (RA;US)
**Testing**
Testing thermal insulations with a thin-heater apparatus, 12:37023 (R;US)
**Thermal Conductivity**
Testing thermal insulations with a thin-heater apparatus, 12:37023 (R;US)
**U Values**
Superinsulated houses: The importance of resale value, 12:37098 (BA;US)
**Vapor Separators**
Membranes improve insulation efficiency, 12:37030 (RA;US)

**THERMAL PHOTOGRAPHY**
*See INFRARED THERMOGRAPHY*

**THERMAL POLLUTION (AIR)**
*See AIR POLLUTION*

**THERMAL POLLUTION (WATER)**
*See WATER POLLUTION*

**THERMAL POWER PLANTS**
*See also COMBINED-CYCLE POWER PLANTS*
*FOSSIL-FUEL POWER PLANTS*
*NUCLEAR POWER PLANTS*
*OCEAN THERMAL POWER PLANTS*
*SOLAR THERMAL POWER PLANTS*
**Retrofitting**
Generating plant life upgrade strategy and results, 12:36759 (BA;US)
**Service Life**
Generating plant life upgrade strategy and results, 12:36759 (BA;US)

**THERMAL RECOVERY**
**Coordinated Research Programs**
Supporting technology for enhanced oil recovery: Third ammendment and extension to Annex IV enhanced oil recovery thermal processes, 12:36377 (R;US)

**THERMAL STORAGE**
*See HEAT STORAGE*

**THERMODYNAMICS**
Continuous thermodynamics for phase equilibria and enthalpy calculations. Annual report, September 1, 1985-December 31, 1986, 12:36464 (R;US)

**THERMOELECTRIC CELLS**
*See THERMOELECTRIC GENERATORS*

**THERMOELECTRIC CONVERSION**
**Electrodes**
Thermoelectric conversion with ion conductors. Quarterly technical progress report No. 2, 1 November 1986-15 January 1987, 12:37007 (R;US)
**Electrolytes**
Thermoelectric conversion with ion conductors. Quarterly technical progress report No. 2, 1 November 1986-15 January 1987, 12:37007 (R;US)

**THERMOELECTRIC CONVERTERS**
*See THERMOELECTRIC GENERATORS*

**THERMOELECTRIC GENERATORS**
**Efficiency**
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**Working Fluids**
Progress toward a mercury heat engine: Synthesis of a mercury electrolyte, 12:37008 (R;US)
**THERMONUCLEAR REACTOR MATERIALS**
**Helium Embrittlement**
The migration and coalescence of tritium-induced helium bubbles during creep in nickel, 12:38388 (J;US)
**THERMONUCLEAR REACTORS**
*For use in cases where certain aspects of either hypothetical or real thermonuclear reactors are discussed.*
*See also ION BEAM FUSION REACTORS*
*STELLARATOR TYPE REACTORS*
*TOKAMAK TYPE REACTORS*
**Breeding**
Tritons and tritides as the solute and diffusing species in ceramic tritium breeders, 12:38370 (R;US)
**Coordinated Research Programs**
Nuclear fusion project. Semi-annual report of the Association KfK/EURATOM. April 1986-September 1986, 12:38381 (R;DE)
**Risk Assessment**
Fusion Safety Program annual report: Fiscal year 1986, 12:38378 (R;US)
**Safety**
Fusion Safety Program annual report: Fiscal year 1986, 12:38378 (R;US)
**THERMONUCLEAR WEAPONS**
*See NUCLEAR WEAPONS*
**THERMOPLASTICS**
**Aging**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**Dielectric Properties**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**Failure Mode Analysis**
Assessment of methods for characterization of polyolefin dielectrics, 12:37367 (BA;US)
**THF**
*See TETRAHYDROFURAN*
**THICKNESS**
*Index only if essential.*
**Measuring Methods**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**THIN FILMS**
**Bragg Reflection**
An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
**Superconducting Junctions**
Superconducting thin films, composites & junctions. Annual report, 1 October 1985-30 September 1986, 12:37450 (R;US)
**X Codes**
An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
**THIO COMPOUNDS**
*See ORGANIC SULFUR COMPOUNDS*
**THIOPHENE**
**Adsorption**
Surface chemistry of model Co-Mo catalysts supported on planar g-Al/sub 2/O/sub 3/: Quarterly technical progress report for period March 1, 1987 to May 31, 1987, 12:36268 (R;US)
**Biodegradation**
Isolation and genetic analysis of mutations allowing the degradation of furans and thiophenes by Escherichia coli, 12:37870 (J;US)
**Electric Impedance**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**Reflectivity**
Impedance and electroreflectance of reduced poly (3-methyl thiophene)-P3MT in an aqueous electrolyte: Direct observation of a polaron transition, 12:36642 (J;US)
**THIOPHENES**
*See POLYCYCLIC SULFUR HETEROCYCLES*
**THIOSORBIC PROCESS**
**Air Pollution Abatement**
Evaluation of solids dewatering for a pilot-scale thiosorbic lime $SO_2$ scrubber. Report for September 1985-April 1986, 12:37653 (R;US)
**THOMASON COLLECTORS**
*See TRICKLE-TYPE COLLECTORS*
**THORAX**
*See CHEST*
**THORIUM 230 TARGET**
**Neutron Reactions**
Coriolis interaction and variable reflection asymmetry in fission vibrational resonances, 12:38277 (J;US)
**THORIUM ALLOYS**
**Specific Heat**
Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure, 12:37228 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**THORIUM B**
*See LEAD 212*
**THORIUM D**
*See LEAD 208*
**THORIUM OXIDES**
**Catalytic Effects**
Production of methanol and light hydrocarbons on $ThO_2$ and doped-$ThO_2$ from CO + $H_2$ mixtures, 12:36603 (R;US)
**Toxicity**
Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer. II, 12:37927 (RA;US)
**THORON**
*See RADON 220*
**THREE MILE ISLAND-2 REACTOR**
*Dauphin County, Pennsylvania, USA*
**Corium**
TMI-2 lower vessel debris examinations, 12:36894 (RA;US)
**Meltdown**
Lessons learned from hydrogen generation and burning during the TMI-2 event, 12:36829 (R;US)
**Molten Metal-Water Reactions**
Lessons learned from hydrogen generation and burning during the TMI-2 event, 12:36829 (R;US)
**Reactor Accidents**
Experimental study of isothermal and boiling liquid jets, 12:36913 (RA;US)
Preliminary results of the TMI-2 core bores, 12:36895 (RA;US)
TMI-2 accident scenario update, 12:36896 (RA;US)
TMI-2 lower vessel debris examinations, 12:36894 (RA;US)
Update on standard problem, data base, and uncertainties, 12:36897 (RA;US)
**THRESHOLD DETECTORS**
**Performance**
Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
**THULIUM 149**
**Beta-Plus Decay**
Observation of /sup 149/Tm decay to /sup 149/Er levels and $\beta$-delayed proton emission, 12:38253 (J;US)
**TIBET**
**Meteorology**
Tibet revisited: TIPMEX-86, 12:37725 (J;US)
**TIDAL POWER**
**Estuaries**
Preliminary survey of tidal energy of U.K. estuaries, 12:36732 (R;GB)

**TIDAL POWER PLANTS**
**Feasibility Studies**
Proposal of a floating tide power plant in Vestmannasund, 12:36734 (R;DK;In Danish)
**TIN**
**Energy-Level Density**
Density-of-states calculations within the recursion method, 12:38303 (J;US)
**Superconducting Junctions**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1985, 12:37448 (R;US)
**TIN ALLOYS**
**Superconductivity**
Superconducting electronic-film structures. Annual report, 1 January-31 December 1986, 12:37325 (R;US)
**TIN ISOTOPES**
**Beta-Plus Decay**
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**Mass Defect**
Towards /sup 100/Sn: Studies on neutron-deficient even isotopes of tin, 12:38252 (R;DE)
**TIN PHOSPHIDES**
**Crystal Structure**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**Electronic Structure**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**Photoconductivity**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**TITANATES**
*Specific compounds, except those of significance to energy research and development, should be indexed by coordination of a descriptor of the form (CATION) COMPOUNDS and the above anion descriptor.*
*See also PZT*
**Acidification**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Electrical Properties**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Fabrication**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Gelation**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Hydrolysis**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Sol-Gel Process**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Structural Chemical Analysis**
The effect of hydrolysis conditions on the characteristics of PbTiO/sub 3/ gels and thin films, 12:37309 (BA;US)
**Superconductivity**
Josephson and quasiparticle tunneling studies of $LiTi_2O_4$, 12:37366 (D;US)
**TITANIUM ALLOYS**
*See also ALLOY-IN-100*
*ALLOY-TZM*
*TITANIUM BASE ALLOYS*
**Fracture Properties**
Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)
**Superconductivity**
Importance of spacing in the development of high current densities in multifilamentary superconductors, 12:37255 (J;GB)
**TITANIUM BASE ALLOYS**
**Shot Peening**
Shot peening for Ti-6Al-4V alloy compressor blades, 12:37229 (R;US)
**TITANIUM CARBIDES**
**Deposition**
AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process, 12:37286 (R;US)
**TITANIUM COMPOUNDS**
*See also TITANATES*
*TITANIUM CARBIDES*
*TITANIUM NITRIDES*
*TITANIUM OXIDES*
**Chemical Preparation**
Precursors of titanium carbonitride, 12:37311 (BA;US)
**TITANIUM NITRIDES**
**Chemical Preparation**
Precursors of titanium carbonitride, 12:37311 (BA;US)
**Deposition**
AES and RBS studies of TiN and TiC coatings prepared by the activated reactive evaporation (ARE) process, 12:37286 (R;US)
**Physical Radiation Effects**
The influence of N-ion irradiation on superconducting TiN, 12:37212 (R;US)
**TITANIUM OXIDES**
**Chemical Reaction Kinetics**
Precipitation kinetics of the titanium isopropoxide hydrolysis reaction, 12:37310 (BA;US)
**Hydrolysis**
Precipitation kinetics of the titanium isopropoxide hydrolysis reaction, 12:37310 (BA;US)
**Precipitation**
Precipitation kinetics of the titanium isopropoxide hydrolysis reaction, 12:37310 (BA;US)
**Raman Spectroscopy**
Raman spectroscopic studies of titanium alkoxides using UV excitation, 12:37426 (BA;US)
**Surface Properties**
Modeling and optimizing surfactant structure to improve oil recovery by chemical flooding at the University of Texas: First annual report for the period October 1985-September 1986, 12:36378 (R;US)
**TMPN**
*See ORGANIC OXYGEN COMPOUNDS*
**TMR REACTORS**
**Loss Cone Instability**
An alpha loss-cone instability in the central cell of a tandem mirror reactor, 12:38325 (R;US)
**TNT**
**Mass Spectroscopy**
Collision-activated dissociation of negative ions in an ion trap mass spectrometer, 12:37383 (J;US)
**TOKAMAK DEVICES**
*See also ALCATOR DEVICE*
*ASDEX TOKAMAK*
*COMPACT IGNITION TOKAMAK*
*FT TOKAMAK*
*TEXT DEVICES*
*TORE SUPRA TOKAMAK*
**Ballooning Instability**
Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
Modification of tokamak ballooning stability boundaries by alpha populations, 12:38323 (R;US)
**Lower Hybrid Heating**
Ray tracing analysis of LH [lower hybrid] fast waves in CCT [Continuous Current Tokamak], 12:38355 (R;US)
**Plasma Confinement**
Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
**Plasma Diagnostics**
Plasma formation and equilibrium in a high $\beta$ tokamak, 12:38361 (J;US)
**Plasma Heating**
Anomalous current penetration and oscillating current drive in tokamaks, 12:38359 (J;US)
**Plasma Production**
Plasma formation and equilibrium in a high $\beta$ tokamak, 12:38361 (J;US)

**Stabilization**
Confinement of a self-stabilized tokamak under average magnetic well conditions, 12:38330 (R;US)
**Wave Propagation**
Ray tracing analysis of LH [lower hybrid] fast waves in CCT [Continuous Current Tokamak], 12:38355 (R;US)
**TOKAMAK FUSION TEST REACTOR**
*See TFTR TOKAMAK*
**TOKAMAK TYPE REACTORS**
*See also COMPACT IGNITION TOKAMAK*
*TFTR TOKAMAK*
**Antennas**
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
**Ballooning Instability**
Effects of ballooning instability on tokamak confinement, 12:38329 (R;US)
Ideal MHD stability properties of pressure-driven modes in low shear tokamaks, 12:38348 (R;US)
**Drift Instability**
Gyrokinetic particle simulation of ion temperature gradient drift instabilities, 12:38353 (R;US)
**ICR Heating**
An algorithm for the calculation of 3-D ICRF [Ion Cyclotron Range of Frequencies] fields in tokamak geometry, 12:38345 (R;US)
ICRF [ion cyclotron range of frequencies] coupling on DIII-D and the implications on ICRF technology development, 12:38373 (R;US)
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
**Pellet Injection**
Pellet injector research at ORNL, 12:38372 (R;US)
**Plasma Confinement**
Effects of ballooning instability on tokamak confinement, 12:38329 (R;US)
**Plasma Diagnostics**
High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics, 12:38347 (R;US)
Ion cyclotron emission calculations using a 2D full wave numerical code, 12:38321 (R;US)
Tokamak physics studies using x-ray diagnostic methods, 12:38346 (R;US)
**Shear**
Ideal MHD stability properties of pressure-driven modes in low shear tokamaks, 12:38348 (R;US)
**TOLUENE**
**Chemical Reactions**
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**Pyrolysis**
Predicting toluene degradation in organic Rankine-cycle engines, 12:37527 (R;US)
**TOMOGRAPHY**
**Gamma Radiation**
Gamma tomography as an aid to experimental enhanced oil recovery, 12:36369 (R;GB)
**TOP PARTICLES**
**Particle Production**
Finding open top, 12:38176 (RA;US)
Monte Carlo models for top production, 12:38175 (RA;US)
Toponium physics with a small data sample, 12:38179 (RA;US)
Toponium-$Z^0$ mixing, 12:38192 (RA;US)
**Semileptonic Decay**
Summary of work on QCD backgrounds to $Z^0 \rightarrow H^0$ anti ell ell, 12:38185 (RA;US)
**TORE SUPRA**
*See TORE SUPRA TOKAMAK*
**TORE SUPRA TOKAMAK**
**Antennas**
Technology development of antennas for ion cyclotron heating experiments in fusion devices, 12:38374 (R;US)
**TOSCOAL PROCESS**
**Hazardous Materials**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
**Noise**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
**TOTAL-ABSORPTION SPECTROMETERS**
*See SHOWER COUNTERS*
**TOWER FOCUS POWER PLANTS**
*See also BARSTOW SOLAR PILOT PLANT*
**Central Receivers**
Cost drivers for solar thermal central receiver power plants, 12:36661 (BA;US)
Value/cost optimization of solar central receiver electric power plants, 12:36662 (BA;US)
**Design**
Design of the small community program (SCSE #2) at Molokai, Hawaii, 12:36677 (BA;US)
**Mathematical Models**
Cost drivers for solar thermal central receiver power plants, 12:36661 (BA;US)
**TOXIC MATERIALS**
*See also TOXINS*
**Air Pollution**
Preliminary compilation of air-pollutant emission factors for selected air toxic compounds, 12:37674 (R;US)
**Air Pollution Control**
National Air Toxics Information Clearinghouse (NATICH) data base user's guide for data entry and editing. Interim report, 12:37641 (R;US)
**Directories**
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 edition. User's guide to the rtecs computer tape. Annual edition, 12:37992 (R;US)
**Emission**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**Environmental Impacts**
Resistance and resilience of pond and stream ecosystems to toxicant stress: Project summary, 12:37838 (R;US)
**Ground Disposal**
Evaluating potential groundwater contamination from contaminated soils, 12:37841 (R;US)
**Hazardous Materials Spills**
Bibliography on chemical emergency preparedness and prevention, 12:36967 (R;US)
**Health Hazards**
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)
**Indoor Air Pollution**
Current Intelligence Bulletin reprints - Bulletins 31 through 47, 12:37888 (R;US)
**Pollution Abatement**
Characterization of long-term toxic emissions from municipal sludge incineration - project plans and status. Research report 1 May 1986-6 April 1987, 12:37158 (R;US)
**Threshold Detectors**
Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
**Volatile Matter**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
**TOXIC SUBSTANCES CONTROL ACT**
Preliminary evaluations of initial TSCA (Toxic Substances Control Act) Section 8(e) substantial risk notices. January 1, 1985 to December 31, 1986, 12:37891 (R;US)
**TOXICITY**
**Alarm Systems**
Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS), 12:37706 (R;US)
**Data Base Management**
Registry of Toxic Effects of Chemical Substances (RTECS), 1986 computer tape. Data files, 12:38005 (R;US)
**TOXINS**
*See also ENDOTOXINS*

**Biosynthesis**
Self-protection of Pseudomonas syringae pv. tabaci from its toxin, tabtoxinine-$\beta$-lactam, 12:37881 (J;US)
**TRACE ELEMENTS**
*See ELEMENTS*
**TRACER TECHNIQUES**
**Analytical Solution**
Mathematical analysis of single-well tracer test, 12:36383 (R;US)
**TRACKLESS VEHICLES**
**Design**
Development of free-steered vehicles, 12:36339 (R;GB)
**TRACKS**
*See PARTICLE TRACKS*
**TRAFFIC CONTROL**
**Cost Estimation**
Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report, 12:37102 (R;ZA)
**Exhaust Gases**
User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)
**Fuel Consumption**
Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report, 12:37102 (R;ZA)
**TRANSFER (HEAT)**
*See HEAT TRANSFER*
**TRANSFER (IN ENVIRONMENT)**
*See RADIONUCLIDE MIGRATION*
**TRANSFER (IN ORGANISM)**
*See RADIONUCLIDE KINETICS*
**TRANSFERASES**
*Code number 2.*
**Enzyme Activity**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
**Tissue Distribution**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
**TRANSFERRIN**
**Chemical Bonds**
Studies of metal binding by the iron transport protein transferrin using time differential perturbed angular correlation spectroscopy, 12:37864 (R;DE;In German)
**TRANSFORMERS**
**Hazardous Materials**
Health-hazard evaluation report HETA 85-289-1738, Page Belcher Federal Building, Tulsa, Oklahoma (PCBs), 12:37675 (R;US)
**TRANSIENT REACTOR TEST FACILITY**
*See TREAT REACTOR*
**TRANSIENTS**
**C Codes**
CSNI validation matrix for PWR and BWR codes, 12:36873 (RA;US)
**Computer Codes**
Application of engineering and multi-dimensional, finite difference codes to HDR thermal mixing experiments, 12:36838 (RA;US)
Code uncertainty quantification, 12:36879 (RA;US)
Sandia code accuracy quantification and its application to TRAC-PF1/MOD1 assessment, 12:36880 (RA;US)
**Computerized Simulation**
BWR plant analyzer development at BNL, 12:36869 (RA;US)
Nuclear plant analyzer development at the Idaho National Engineering Laboratory, 12:36868 (RA;US)
**R Codes**
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
Finnish assessment of RELAP5/MOD2, 12:36875 (RA;US)
JRC ISPRA experience with the IBM version of RELAP5/MOD2, 12:36884 (RA;US)
Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG, 12:36872 (RA;US)
**T Codes**
Assessment of uncertainty identification for RELAP5/MOD2 and TRAC-BD1/MOD1 1 codes under core uncovery and reflooding conditions, 12:36885 (RA;US)
Cold leg condensation in a large break LOCA using TRAC-PF1/MOD1, 12:36882 (RA;US)
Results from assessment of RELAP5/MOD2 and TRAC-PF1 in the FRG, 12:36872 (RA;US)
Status of J-TRAC code development, 12:36887 (RA;US)
Tests of the TRAC code against known analytical solutions for stratified flow, 12:36881 (RA;US)
Three-D neutronics model implementation into TRAC-BD1, 12:36877 (RA;US)
TRAC development at General Electric, 12:36876 (RA;US)
Validation of TRAC-PD2 against experiment LP-02-6 of the OECD-LOFT series, 12:36878 (RA;US)
**TRANSITION ELEMENT COMPLEXES**
*See also COBALT COMPLEXES*
*IRON COMPLEXES*
*MANGANESE COMPLEXES*
*NICKEL COMPLEXES*
*PALLADIUM COMPLEXES*
*PLATINUM COMPLEXES*
*RHODIUM COMPLEXES*
**Catalytic Effects**
Coal liquefaction using transition metal carbonyl catalysts, 12:36262 (RA;US)
Transition metal catalysis of hydrogen shuttling in coal liquefaction: Quarterly technical progress report, 9/1/86-11/30/86, 12:36266 (R;US)
**Chemical Preparation**
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**Performance Testing**
The study of some transition metals complexes as process catalysts: Quarterly report for the period March 1, 1987 through May 31, 1987, 12:36265 (R;US)
**TRANSITION ELEMENTS**
*See also CHROMIUM*
*COBALT*
*COPPER*
*GOLD*
*IRON*
*MANGANESE*
*MOLYBDENUM*
*NICKEL*
*NIOBIUM*
*SILVER*
*TUNGSTEN*
*ZIRCONIUM*
**Solvent Extraction**
Metal ion complexation by ionizable crown ethers: Progress report, January 1, 1985-December 31, 1987, 12:37374 (R;US)
**TRANSITION METALS**
*See TRANSITION ELEMENTS*
**TRANSMISSION (DATA)**
*See DATA TRANSMISSION*
**TRANSMISSION ELECTRON MICROSCOPY**
**Image Processing**
Interactive software for simulation of high resolution TEM images, 12:38411 (R;US)
**TRANSMISSION (HEAT)**
*See HEAT TRANSFER*
**TRANSMISSION LINES**
*See POWER TRANSMISSION LINES*
**TRANSPORT (CHARGED-PARTICLE)**
*See CHARGED-PARTICLE TRANSPORT*
**TRANSPORT (ENVIRONMENTAL)**
*See ENVIRONMENTAL TRANSPORT*
**TRANSPORT (IN ORGANISMS)**
*See RADIONUCLIDE KINETICS*
**TRANSPORT THEORY**
**Numerical Solution**
Orbit extension method for finding unstable orbits, 12:38333 (R;US)
**TRANSPORTATION SECTOR**
**Energy Expenses**
Transportation energy outlook under conditions of persistently low petroleum prices, 12:36416 (R;US)

**Maintenance Facilities**
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
**Refrigeration**
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)
**TRANSURANIUM ELEMENTS**
*See also PLUTONIUM*
**Beta Decay**
Beta decay of neutron-rich transuranic nuclei, 12:38264 (BA;DE)
**Measuring Methods**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**Recovery**
Recovery of transuranics from process residues, 12:36513 (R;US)
**Removal**
Pretreatment of Hanford PUREX Plant first-cycle waste, 12:36532 (R;US)
**TRANSURANIUM WASTES**
*See ALPHA-BEARING WASTES*
**TREAT REACTOR**
**Fission Product Release**
Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions, 12:36824 (R;US)
**Fuel Pins**
Transient survivability of LMR oxide fuel pins, 12:36820 (R;US)
**Reactor Safety Experiments**
Sampling and characterization of aerosols produced under simulated nuclear reactor accident conditions, 12:36824 (R;US)
**TREE RINGS**
**Annual Variations**
Annual ring analysis on conifers for the description and assessment of forest damage (the Valais, Switzerland), 12:37602 (RA;US)
Comparative studies on the annual ring pattern and crown condition of conifers (the Valais, Switzerland), 12:37754 (RA;US)
**Chemical Composition**
History of the chemical environment from elemental analysis of tree rings, 12:37956 (RA;US)
Potential in using elemental concentrations in radial increments of old growth eastern red cedar to examine the chemical history of the environment, 12:38035 (RA;US)
**Computerized Tomography**
How to observe tree-ring without really cutting, 12:38034 (RA;US)
**Density**
Current status of X-ray densitometry, 12:37764 (RA;US)
Red spruce tree-ring density and growth decline, 12:37753 (RA;US)
**Ecology**
Principles and practices of dendroecology, 12:37734 (RA;US)
**Evaluation**
Densitometric and ring width analysis of 3-year-old Pinus taeda L. and Liquidambar styraciflua L.; grown under three levels of $CO_2$ and two water regimes, 12:37951 (RA;US)
High-precision, low-cost dendrochronograph, 12:37454 (RA;US)
Seedling response to $CO_2$ enrichment under stressed and non-stressed conditions, 12:37952 (RA;US)
Thin-section technique for X-ray densitometric analysis of narrow tree-ring series, 12:38032 (RA;US)
Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies, 12:37762 (RA;US)
Tree-ring analysis in the earth sciences, 12:37751 (RA;US)
Urban dendrochronology, 12:37755 (RA;US)
**Geographical Variations**
Spatial distribution of light-ring years in subarctic Quebec, 12:37741 (RA;US)
**Image Processing**
Progress in the image analysis of tree rings, 12:38033 (RA;US)
**Inventories**
Environmental stresses and residual variation in European tree-ring data after climatic influence is removed, 12:38030 (RA;US)
**Isotope Dating**
Influence of site disturbance on $\delta^{13}C$ isotopic time series from tree rings, 12:38019 (RA;US)
**Mapping**
Tree-ring reconstruction of Indian-Cree tree harvesting in the area, Quebec, Poste-de-la-Baleine, 12:38029 (RA;US)
**Mathematical Models**
Disaggregation of tree-ring series for environmental studies, 12:37758 (RA;US)
Tree-growth, ARMA modelling and pollution, 12:37955 (RA;US)
**Measuring Methods**
Method to obtain thin cross-sections for tree-ring analysis, 12:38036 (RA;US)
**Time-Series Analysis**
History of the chemical environment from elemental analysis of tree rings, 12:37956 (RA;US)
Influence of site disturbance on $\delta^{13}C$ isotopic time series from tree rings, 12:38019 (RA;US)
Intervention detection - a systematic technique for examining shifts in radial growth rates of forest trees, 12:37858 (RA;US)
Potential in using elemental concentrations in radial increments of old growth eastern red cedar to examine the chemical history of the environment, 12:38035 (RA;US)
Some applications of the Kalman filter to tree-ring analysis, 12:37760 (RA;US)
Time-series analysis applied to tree-ring series, 12:37759 (RA;US)
**Variations**
Cypress tree-ring analysis in relation to wetlands and hydrology (Taxodium distichum), 12:37832 (RA;US)
Dating earthquakes along the San Andreas fault system in California, 12:37752 (RA;US)
Dendrochronological study of oak trunks found in bogs in northwest Germany, 12:38025 (RA;US)
Forest disturbance and tree-ring analysis, 12:37744 (RA;US)
Late Holocene sediment yield and transport in a northern Arizona drainage basin reconstructed by tree-ring analysis, 12:38020 (RA;US)
Potential for use of cottonwoods as indicators of past floods, 12:37831 (RA;US)
Southern forest growth trends: air pollution influence studies and tree-ring analysis, 12:37943 (RA;US)
Tree-ring studies and the reconstruction of woodland management practices in antiquity, 12:38027 (RA;US)
Tree-rings and insects: the influence of cockchafers on the development of growth rings in oak trees, 12:37745 (RA;US)
Western spruce budworm outbreaks in northern New Mexico: tree-ring evidence of occurrence and radial growth impacts from 1700 to 1983, 12:37883 (RA;US)
**Width**
Dendroecological analysis of a population of black gum (Nyssa sylvatic Marsh.) in southern Ontario, Canada, 12:37740 (RA;US)
Disaggregation of tree-ring series for environmental studies, 12:37758 (RA;US)
Environmental stresses and residual variation in European tree-ring data after climatic influence is removed, 12:38030 (RA;US)
Management effects in British tree-ring series, 12:37757 (RA;US)
Method to obtain thin cross-sections for tree-ring analysis, 12:38036 (RA;US)
Network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide, 12:37950 (RA;US)
Productivity in fossil forests, 12:38026 (RA;US)

Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
Recent abnormal increase in tree-ring widths: a possible effect of elevated atmospheric carbon dioxide, 12:37953 (RA;US)
Time-dependent responses of trees to weather variations an application of the Kalman filter, 12:37954 (RA;US)

**TREES**

*See also ASPENS*
*BEECH TREES*
*BIRCHES*
*CEDARS*
*COTTONWOODS*
*FIRS*
*MAPLES*
*OAKS*
*PINES*
*POPLARS*
*SPRUCES*
*SYCAMORES*
*WILLOWS*

**Age Estimation**
Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies, 12:37762 (RA;US)

**Biological Stress**
Cypress tree-ring analysis in relation to wetlands and hydrology, 12:37832 (RA;US)
Fire and stand histories in subalpine forests on the Thredbo ski slopes, Koscuisko, National Park, NSW, Australia, 12:37747 (RA;US)
Influence of site disturbance on $\delta 13C$ isotopic time series from tree rings, 12:38019 (RA;US)
Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
Urban dendrochronology, 12:37755 (RA;US)

**Competition**
Dendroecological approach for studying inter-tree competition, 12:37738 (RA;US)

**Isotope Dating**
Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)

**Plant Growth**
Abrupt changes in growth reflected in tree ring sequences as an expression of biotic and abiotic influences, 12:37798 (RA;DE)
Annual rings of trees from Central Amazonian inundation forests, 12:38022 (RA;US)
Cypress tree-ring analysis in relation to wetlands and hydrology, 12:37832 (RA;US)
Dating landslides in Hudson Bay area, Quebec, 12:38023 (RA;US)
Dendroecological approach for studying inter-tree competition, 12:37738 (RA;US)
Dendroecological analysis of a population of black gum (Nyssa sylvatic Marsh.) in southern Ontario, Canada, 12:37740 (RA;US)
Dendroecological analysis of ambient sulfur dioxide effects in western larch, 12:37947 (RA;US)
Extended growth decreases in New England are limited to red spruce and balsam fir, 12:37737 (RA;US)
New analysis of branches, boles, and roots for predicting historical changes in photosynthesis, respiration, and carbon allocation below ground, 12:37733 (RA;US)
Potentials and limitations of dendrochronology in pollution research, 12:37806 (RA;US)
Principles and practices of dendroecology, 12:37734 (RA;US)
Productivity in fossil forests, 12:38026 (RA;US)
Radiodensitometric tree-ring along altitudinal gradients: some alternative procedures for detecting site, climatic, and potential $CO_2$ effects on tree growth, 12:37949 (RA;US)
Spatial distribution of light-ring years in subarctic Quebec, 12:37741 (RA;US)
Trade-offs between the use of tree-ring counting and dendrochronology in ecological studies, 12:37762 (RA;US)
Urban dendrochronology, 12:37755 (RA;US)
Variations of the standard error/mean index ratio on wetland sites, 12:37763 (RA;US)
White alder growth and development: the effect of small hydroelectric projects in the Sierra Nevada of California, 12:36616 (RA;US)

**Population Dynamics**
Dendroecological analysis of a population of black gum (Nyssa sylvatic Marsh.) in southern Ontario, Canada, 12:37740 (RA;US)

**Spatial Distribution**
Spatial distribution of light-ring years in subarctic Quebec, 12:37741 (RA;US)

**TRIBUTYL PHOSPHATE**
*See TBP*

**TRICKLE-TYPE COLLECTORS**
**Seasonal Variations**
Trickle-flow solar collector; far higher efficiencies during cold weather, 12:36716 (BA;US)

**Thermal Efficiency**
Trickle-flow solar collector; far higher efficiencies during cold weather, 12:36716 (BA;US)

**TRIHYDROXYBENZOIC ACID**
*See GALLIC ACID*

**TRINITROTOLUENE**
*See TNT*

**TRIPLET PARTICLES**
*See QUARKS*

**TRITIUM**
**Accounting**
A measurement control study for tritium gas, 12:36563 (R;US)

**Beta Decay**
Limit on the anti $\nu$ mass in free molecular tritium beta decay, 12:38152 (BA;DE)

**Beta Spectroscopy**
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)

**Beta-Minus Decay**
An experiment to measure the electron neutrino mass using a cryogenic tritium source, 12:38198 (R;US)
The Los Alamos free atomic tritium beta decay experiment, 12:38236 (BA;US)

**Diffusion**
Tritons and tritides as the solute and diffusing species in ceramic tritium breeders, 12:38370 (R;US)

**Environmental Transport**
Statistical structure and filter characteristics of tritium fluctuations in fractured basalt, 12:36541 (J;US)

**Fluctuations**
Statistical structure and filter characteristics of tritium fluctuations in fractured basalt, 12:36541 (J;US)

**Measuring Methods**
A measurement control study for tritium gas, 12:36563 (R;US)

**Muon-Catalyzed Fusion**
Some thoughts on the muon catalyzed fusion reactor, 12:39320 (R;US)

**Radioactivity**
Environmental surveillance at Los Alamos during 1986, 12:37711 (R;US)

**Radioecological Concentration**
Tritium in groundwater at Site 300, 12:37853 (R;US)

**TRITIUM TARGET**
**Proton Reactions**
Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Progress report, [1986-1987], 12:38229 (R;US)

**TRITON REACTIONS**
**Pickup Reactions**
Ir(t-arrow-right,$\alpha$)Os reaction and implications for tests of supersymmetries, 12:38262 (J;US)

**TRU WASTES**
*See ALPHA-BEARING WASTES*
**TRUCKS**
**Diesel Engines**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Marketing Research**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**Public Opinion**
A case study of the commercialization of the diesel engine in the domestic light duty vehicle market: Final report, 12:37161 (R;US)
**TRX-1**
*See REVERSE-FIELD PINCH*
**TSL PROCESS**
**Mathematical Models**
Modeling of Wilsonville Integrated Two-stage Liquefaction (ITSL) process, 12:36261 (RA;US)
**Test Facilities**
Integrated two-stage liquefaction of subbituminous coal: The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama: Final report, 12:36273 (R;US)
**TTF**
**Crystal Structure**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Electric Conductivity**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**Synthesis**
Synthesis, structure and properties of BEDT-TTF derivatives, 12:37408 (R;US)
**TUBES**
*For objects of tubular shape; not for DRIFT TUBES, ELECTRON TUBES or IMAGE STORAGE TUBES.*
**Resistance Welding**
Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**TUBES (CONDUITS)**
*See PIPES*
**TUFF**
**Stresses**
Analysis of a proposed NNWSI exploratory shaft slot test for tuff response, 12:36537 (R;US)
**Thermodynamic Properties**
Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project (NNWSI), 12:36539 (R;US)
**TUMORS**
*See NEOPLASMS*
**TUNGSTEN**
**Compression**
Dynamic quasi-isentropic compression of tungsten, 12:37241 (R;US)
**Shock Waves**
Dynamic quasi-isentropic compression of tungsten, 12:37241 (R;US)
**TURBINE BLADES**
**Microstructure**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Ultrasonic Testing**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**TURBULENCE**
**Perturbation Theory**
Interpretation of the Yakhot—Orszag turbulence theory, 12:38108 (J;US)
**TURBULENT FLOW**
**Algorithms**
Algorithm implementation on the Navier-Stokes computer, 12:37495 (R;US)
**Flow Visualization**
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer. Final report, 12:37496 (R;US)
**Fluctuations**
Modeling the viscous wall region, 12:38107 (J;US)
**Mathematical Models**
Numerical calculation of turbulent flow around a cubic element, 12:37498 (R;DE;In German)
**Strains**
Alignment of vorticity and scalar gradient with strain rate in simulated Navier—Stokes turbulence, 12:38106 (J;US)
**Vortices**
Alignment of vorticity and scalar gradient with strain rate in simulated Navier—Stokes turbulence, 12:38106 (J;US)
**TURNOVER (RADIONUCLIDES)**
*See RADIONUCLIDE KINETICS*
**TWO-PHASE FLOW**
Determination of heat transfer in pool boiling and forced convective boiling, 12:37501 (R;FI;In Finnish)
Gas-liquid pipe flow with drag reducers. Doctoral thesis, 12:37499 (R;NL;In Dutch)
**Flow Models**
Pseudo-two-dimensional steady state two-phase flow model for gas-solids vertical pneumatic conveying systems, 12:37504 (B;US)
**Mathematical Models**
Modified drift-flux model and weir model to describe two-phase flow in a pipe with inverted u-bend, 12:36854 (RA;US)
**TYROSINE**
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)
**TZM**
*See ALLOY-TZM*

## U

**UCLLL**
*See LAWRENCE LIVERMORE LABORATORY*
**ULTRACENTRIFUGE ENRICHMENT PLANTS**
*See CENTRIFUGE ENRICHMENT PLANTS*
**ULTRASONIC WAVES**
**Angular Distribution**
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
**Attenuation**
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)
**Backscattering**
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**Corrections**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
**Diffraction**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)
**Image Processing**
Ultrasonic signal analysis of composite structures using the entire waveform, 12:37364 (BA;US)

**Incidence Angle**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Kramers-Kronig Correlation**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
**Mathematical Models**
Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
Porosity characterization in fiber-reinforced composites by use of ultrasonic backscatter, 12:37363 (BA;US)
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)
**Multiple Scattering**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
**Phase Shift**
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
**Phase Velocity**
Influence of plate wave characteristics on the angular dependence of ultrasonic velocities, 12:37265 (BA;US)
Ultrasonic NDE of green-state ceramics by focused through-transmission, 12:37307 (BA;US)
Use of ultrasonics for texture monitoring in aluminum alloys, 12:37264 (BA;US)
**Reflection**
Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Refraction**
Effects of reflection and refraction of ultrasonic waves on the angle beam inspection of anisotropic composite material, 12:37362 (BA;US)
**Scattering Amplitudes**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Transmission**
Determining crack tip shielding by means of acoustic transmission and diffraction measurements, 12:37266 (BA;US)

**ULTRASONICS**
*See ULTRASONIC WAVES*

**UNDERGROUND DISPOSAL**
**Feasibility Studies**
Technical correspondence in support of the Site Characterization Plan: Nevada Nuclear Waste Storage Investigations Project, 12:36539 (R;US)
**Heat Transfer**
Comparison of results for ten analytical heat conduction problems as solved by the general heat transfer code HEATING5 [Heat Engineering and Transfer in Nine Geometries], 12:36498 (R;US)
**Risk Assessment**
Risk assessment of soil contamination criteria, 12:37821 (R;US)
**Stress Analysis**
Thermomechanical analysis of underground excavations in the vicinity of a nuclear waste isolation panel, 12:36534 (R;US)

**UNDERGROUND HEAT DISTRIBUTION SYSTEMS**
*See HEAT DISTRIBUTION SYSTEMS*

**UNDERGROUND MINING**
*See also CAVING MINING*
*LONGWALL MINING*
*ROOM AND PILLAR MINING*
**Drilling Equipment**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**Fire Prevention**
Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986, 12:36342 (R;US)
**Mining Equipment**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**Trackless Vehicles**
Development of free-steered vehicles, 12:36339 (R;GB)
**Ventilation**
Evaluating ventilation parameters of three coal-mine gobs. Information circular/1986, 12:36342 (R;US)

**UNIFIED GAUGE MODELS**
*See also GRAND UNIFIED THEORY*
*STANDARD MODEL*
*WEINBERG-SALAM GAUGE MODEL*
**Beta Decay**
Constraints on general SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models from nuclear beta decay, 12:38210 (BA;DE)

**UNION OF SOVIET SOCIALIST REPUBLICS**
*See USSR*

**UNITED KINGDOM**
**Energy Policy**
A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)
**Estuaries**
Suspended fine cohesive sediment in the Severn Estuary and inner Bristol Channel, UK , 12:36733 (R;GB)
**Fossil Fuels**
A statistical analysis of the UK steam boiler stock, 12:36991 (J;GB)
**Geothermal Energy**
Cleethorpes geothermal exploration borehole. Drilling and testing programme. General report , 12:36722 (R;GB)
**Renewable Energy Sources**
Contribution of renewable energy technologies to future energy requirements, 12:37004 (J;GB)
**Tidal Power**
Preliminary survey of tidal energy of U.K. estuaries, 12:36732 (R;GB)

**UNITED STATES OF AMERICA**
*See USA*

**UNIVERSITIES**
*See EDUCATIONAL FACILITIES*

**UNLEADED GASOLINE**
**Carcinogenesis**
Evaluation of the carcinogenicity of unleaded gasoline, 12:38002 (R;US)
**Health Hazards**
Evaluation of the carcinogenicity of unleaded gasoline, 12:38002 (R;US)

**UPSILON RESONANCES**
*See also UPSILON-10000 RESONANCES*
*UPSILON-10500 RESONANCES*
*UPSILON-9500 RESONANCES*
**Leptonic Decay**
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
**Particle Production**
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)
**Radiative Decay**
Recent results on upsilon physics from CUSB-II, 12:38137 (RA;US)

**UPSILON-10000 RESONANCES**
**Particle Production**
Recent results from ARGUS, 12:38136 (RA;US)

**UPSILON-10500 RESONANCES**
**Particle Production**
Recent results from ARGUS, 12:38136 (RA;US)

**UPSILON-9500 RESONANCES**
**Particle Production**
Recent results from ARGUS, 12:38136 (RA;US)
Recent results from the crystal ball experiment, 12:38138 (RA;US)
**Radiative Decay**
Recent results from the crystal ball experiment, 12:38138 (RA;US)

**URANIUM**
*See also NATURAL URANIUM*
**Anisotropy**
Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate, 12:37232 (R;US)

**Ductile-Brittle Transitions**
Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate, 12:37232 (R;US)
**Enrichment**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**Forecasting**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Ion-Atom Collisions**
Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)
**Market**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Milling**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**Mining**
Update of Table S-3 nonradiological environmental parameters for a reference light-water reactor: Uranium mining, milling, and enrichment, 12:36799 (R;US)
**Photonuclear Reactions**
Calculation of pair production by 10 and 20 MeV photons, 12:38275 (J;US)
**Recovery**
Canyon solvent cleaning (HM Process solvent), 12:36485 (R;US)
Canyon solvent cleaning with solid adsorbents (HM Process solvent (TBP in n-paraffin)), 12:36486 (R;US)
**Strain Hardening**
Toughness anisotropy and the ductile brittle transition of warm-rolled, hot-rolled, and beta-treated uranium plate, 12:37232 (R;US)
**Supply and Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Toxicity**
Mortality among uranium enrichment workers, 12:36480 (R;US)

**URANIUM 234**
**Indoor Air Pollution**
Mortality among uranium enrichment workers, 12:36480 (R;US)

**URANIUM 235**
**Indoor Air Pollution**
Mortality among uranium enrichment workers, 12:36480 (R;US)
**Laser Isotope Separation**
An overview of copper-laser development for isotope separation, 12:36481 (R;US)
**Nuclear Materials Management**
A nondestructive assay standards program at the Savannah River Plant, 12:36559 (R;US)

**URANIUM 238 TARGET**
**Oxygen 16 Reactions**
Energetic particle emission and linear momentum transfer in central collisions induced by 32.5 MeV/nucleon $^{16}O$ + $^{238}U$, $^{197}Au$, 12:38261 (R;US)

**URANIUM ALLOYS**
**Kondo Effect**
f-band narrowing in uranium intermetallics, 12:37206 (R;US)
**Specific Heat**
Specific heat of (U/sub 0.97/Th/sub 0.03/)$Be_{13}$ under pressure, 12:37228 (R;US)
**Spectra**
Understanding photoemission spectra in uranium based heavy fermion systems, 12:37204 (R;US)
**Superconductivity**
Mass renormalizations and superconductivity in heavy-fermion $UPt_3$, 12:37252 (J;US)

**URANIUM II**
*See URANIUM 234*

**URANIUM IONS**
**Ion-Atom Collisions**
Multiple positron structures observed from U-U collisions at 5.6 MeV/u and 5.9 MeV/u, 12:38095 (R;DE)

**URANIUM MILLS**
*See FEED MATERIALS PLANTS*

**URANIUM PHOSPHATES**
**Mining**
Multidisciplinary study of radionuclides and heavy-metal concentrations in wildlife on phosphate-mined and reclaimed lands. Final report, 12:36551 (R;US)

**URANYL FLUORIDES**
**Indoor Air Pollution**
Mortality among uranium enrichment workers, 12:36480 (R;US)

**URBAN AREAS**
**Air Pollution**
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
**Air Quality**
Episodic coincident air-quality and precipitation measurements in an urban setting, 12:37664 (R;US)
National air quality and emissions trends report, 1985, 12:37657 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 1. Adaptation of the mechanism. Final report, March 1986-February 1987, 12:37660 (R;US)
Surrogate-species chemical-reaction mechanism for urban-scale air-quality simulation models. Volume 2. Guidelines for using the mechanism. Final report, March 1986-February 1987, 12:37661 (R;US)
**Energy Consumption**
Dense in a right way. Energy aspects on the expansion of Gothenburg, 12:37021 (R;SE;In Swedish)
**Mass Transit Systems**
Baltimore feeder-bus planning study. Final report, 12:37100 (R;US)
Non-federal funding for transit systems: state-of-the-art case analyses. Final report, 1983-1985, 12:37099 (R;US)
**Plant Growth**
Urban dendrochronology, 12:37755 (RA;US)

**US AEC**
*Includes all AEC-associated organizations.*
*See also LASL*
*LAWRENCE LIVERMORE LABORATORY*
*ORNL*
*ROCKY FLATS PLANT*
*SAVANNAH RIVER PLANT*
*Y-12 PLANT*
**Historical Aspects**
A history of the United States Atomic Energy Commission, 1952-1960: Volume 3, 12:37593 (R;US)

**US ATOMIC ENERGY COMMISSION**
*See US AEC*

**US DOD**
**Communications**
Virtual communications to ASD's (Aeronautical Systems Division's) Cray computer via AFIT data communications resources. Master's thesis, 12:38406 (R;US)

**US DOE**
*See also BONNEVILLE POWER ADMINISTRATION*
*HANFORD RESERVATION*
*IDAHO NATIONAL ENGINEERING LABORATORY*
*LASL*
*LAWRENCE LIVERMORE LABORATORY*
*NEVADA TEST SITE*
*ORGDP*
*ORNL*
*PANTEX PLANT*
*PORTSMOUTH GASEOUS DIFFUSION PLANT*
*ROCKY FLATS PLANT*
*SAVANNAH RIVER PLANT*
*STANFORD LINEAR ACCELERATOR CENTER*
*WIPP*
*Y-12 PLANT*
**Contracts**
Doing business with the Department of Energy, 12:38394 (R;US)

**Emergency Plans**
Department of Energy Emergency Management Functional Requirements Study, 12:36558 (R;US)
**Environmental Policy**
Environmental Regulatory Update Table, May 1987, 12:36962 (R;US)
**Financial Assistance**
Doing business with the Department of Energy, 12:38394 (R;US)
**Procurement**
Doing business with the Department of Energy, 12:38394 (R;US)
**Program Management**
Review of the National Research Council report: Physics through the 1990's (Energy research), 12:36972 (R;US)
**Research Programs**
Office of Basic Energy Sciences: 1986 summary report, 12:38393 (R;US)
Quarterly status of Department of Energy Projects, 12:36971 (R;US)

**US EPA**
**Water Quality**
Water-quality-modeling software available from US EPA (Environmental Protection Agency), 12:37839 (R;US)
**Wetlands**
EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)

**US NRC**
*United States Nuclear Regulatory Commission-prior to 1975 was part of US AEC.*
**Bibliographies**
Title list of documents made publicly available: April 1-30, 1987, 12:36791 (R;US)
Title list of documents made publicly available: February 1-28, 1987, 12:36790 (R;US)
**Decisions and Orders**
Nuclear Regulatory Commission issuances, 12:36793 (R;US)
**Enforcement**
Enforcement actions: Significant actions resolved: Quarterly progress report, October-December 1986, 12:36976 (R;US)
**Indexes**
Indexes to Nuclear Regulatory Commission issuances, July-September 1986, 12:36792 (R;US)
**Legal Aspects**
NRC Regulatory Agenda: Quarterly report, January-March 1987, 12:36794 (R;US)
**Reactor Licensing**
NRC Incident Response Plan, 12:36833 (R;US)
**Reporting Requirements**
NRC Incident Response Plan, 12:36833 (R;US)
**Response Functions**
NRC Incident Response Plan, 12:36833 (R;US)

**US WATER POLLUTION CONTROL ACT**
*See CLEAN WATER ACT*

**USA**
*See also FEDERAL REGION I*
*GREAT BASIN*
**Coal Reserves**
Sulfur reduction from coal through physical beneficiation, 12:36229 (R;US)
**Energy Demand**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Energy Management**
Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)
**Energy Policy**
Municipal responses to the energy challenge: Davis, California. Grassroots involvement in energy conservation and planning, 12:36950 (R;DE)
**Energy Supplies**
Documentation of the integrating module and stock module of the intermediate future forecasting system, 12:36949 (R;US)
**Great Lakes**
Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report, 12:37845 (R;US)
**Natural Gas Deposits**
Projections of cost of development of US natural gas potential: Final report, 12:36437 (R;US)
**Petroleum**
Kalman-filter estimation of monthly US oil imports, 12:36418 (J;GB)
**Resource Conservation**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)

**USSR**
**Energy Policy**
Background paper: Soviet energy policy, 12:36981 (RA;SE)
Energy policy in the USSR, 12:36982 (RA;SE)
Energy situation and politics in the USSR, 12:36983 (RA;SE)
**Energy Sources**
Conclusions from the seminar, 12:36988 (RA;SE)
**Exports**
Soviet energy exports to world markets, 12:36990 (RA;SE)
**Trade**
Conclusions from the seminar, 12:36988 (RA;SE)
Soviet energy. Proceedings from an international seminar, 12:36987 (R;SE)

**UTERINE CERVIX CARCINOMA**
*See CARCINOMAS*

**UTILITIES**
*See ELECTRIC UTILITIES*
*PUBLIC UTILITIES*

## V

**V CODES**
VAWT stochastic wind simulator, 12:36742 (R;US)

**VA CHARACTERISTIC**
*See ELECTRIC CONDUCTIVITY*

**VALVES**
**Design**
Coal slurry letdown device, 12:36255 (RA;US)
Slurry valve development, 12:36246 (RA;US)
**Electroslag Casting**
Electroslag component casting, 12:36250 (RA;US)
**Performance Testing**
Coal slurry letdown device, 12:36255 (RA;US)
Slurry valve development, 12:36246 (RA;US)

**VANADIUM 51 TARGET**
**Carbon 12 Reactions**
Statistical GDR [Giant Dipole Resonances] decay of highly excited states of $^{63}$Cu, 12:38244 (R;US)
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Pion Plus Reactions**
Studies of hypernuclei by associated production, 12:38237 (R;US)

**VANADIUM ALLOYS**
*See also ALLOY-IN-100*
**Fracture Properties**
Influence of microstructure and microdamage processes on fracture at high loading rates. Annual report No. 1, February 1986-January 1987, 12:37199 (R;US)
**Shot Peening**
Shot peening for Ti-6Al-4V alloy compressor blades, 12:37229 (R;US)

**VANADIUM MINERALS**
*See MINERALS*

**VANADIUM OXIDES**
**Catalytic Effects**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)

**VECTOR PROCESSING**
Vector-array-processor computer equipment. Final report, 1 January-31 December 1985, 12:38052 (R;US)

**Computer Architecture**
Performance comparison of four state-of-the-art computer architectures. Master's thesis, 12:38401 (R;US)

**VECTORS**
Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis, 12:38307 (R;US)

**VEGETABLE OILS**
*Prior to March 1983 this concept was indexed to PLANTS and OILS.*
*See also SOYBEAN OIL*
**Chemical Preparation**
Stability and composition of palm, coconut and soy oil fatty acid microemulsion diesel fuels, 12:36605 (BA;US)

**VEGETATION**
*See PLANTS*

**VEHICLES**
*See also AUTOMOBILES*
*ELECTRIC-POWERED VEHICLES*
*RECREATIONAL VEHICLES*
*SPACE VEHICLES*
*TRACKLESS VEHICLES*
*TRUCKS*
**Air Pollution**
Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report), 12:37599 (R;US)
**Brakes**
In-depth survey report: control technology for brake-drum service operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, 12:37685 (R;US)
**Data Transmission**
Vehicle tracking systems, 12:38396 (R;US)
**Exhaust Gases**
User's guide to the TEXIN2 model--a model for predicting carbon monoxide concentrations near intersections. Interim research report, September 1979-August 1986, 12:37184 (R;US)
**Monitoring**
A neutron portal monitor for vehicles, 12:36562 (R;US)
**Navigation**
Vehicle tracking systems, 12:38396 (R;US)
**Refrigeration**
Potential of the tractor-trailer and container segments as entry markets for a proposed refrigeration technology, 12:37103 (R;US)
**Traffic Control**
Full and fractional stop costs and traffic stream performance during speed change cycles. Technical report, 12:37102 (R;ZA)

**VENTILATION SYSTEMS**
**Air Flow**
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Air Quality**
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)
**Ducts**
Test equipment system to study the dynamics and the controlability of air conditioning processes, 12:37082 (R;FI;In Finnish)
**Field Tests**
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Mathematical Models**
Prerequisities for functioning of the natural ventilation, 12:37093 (R;FI;In Finnish)
**Particles**
Indoor particle concentration and the outdoor to indoor transport. Part 3. Effects of airconditioning systems, 12:37088 (R;FI;In Finnish)

**VENTS**
**Draft Control Systems**
Measured energy savings from vent dampers in low rise apartment buildings, 12:37041 (RA;US)
**Safety Engineering**
Flame acceleration in mixtures of hydrogen and air, 12:36579 (R;US)

**VENUS REACTOR**
**Mixed Oxide Fuels**
Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II, 12:36777 (R;US)
**Reactor Lattices**
Diffusion theory calculations for the pin-wise power distribution in VENUS-I and VENUS-II, 12:36777 (R;US)

**VERIFICATION**
**Research Programs**
Arms control activities in LLNL, 12:37195 (J;US)
**Technology Assessment**
Arms control and treaty verification technology: Contributions from the nonweapons laboratories, 12:37194 (R;US)

**VERTEBRAE**
**Biomedical Radiography**
Mechanical and morphological evaluation of age-related changes in the Beagle spine, 12:37876 (RA;US)
**Morphology**
Mechanical and morphological evaluation of age-related changes in the Beagle spine, 12:37876 (RA;US)

**VERTICAL AXIS TURBINES**
**Computerized Simulation**
VAWT stochastic wind simulator, 12:36742 (R;US)
**Design**
Sandia National Laboratories 34-meter diameter vertical axis wind turbine test bed, 12:36747 (BA;US)
Structural design and fabrication of the Sandia 34-meter vertical axis wind turbine, 12:36746 (BA;US)
**Fabrication**
Structural design and fabrication of the Sandia 34-meter vertical axis wind turbine, 12:36746 (BA;US)
**Test Facilities**
Sandia National Laboratories 34-meter diameter vertical axis wind turbine test bed, 12:36747 (BA;US)

**VESSELS**
*See CONTAINERS*

**VESSELS (CHEMICAL REACTIONS)**
*See CHEMICAL REACTORS*

**VESSELS (PRESSURE)**
*See PRESSURE VESSELS*

**VIBRATIONS (MECHANICAL)**
*See MECHANICAL VIBRATIONS*

**VINYL CYANIDE**
*See ACRYLONITRILE*

**VINYL MONOMERS**
**Electrochemistry**
Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene, 12:37433 (J;US)
**Polymerization**
Fluorescence emission as a probe to investigate electrochemical polymerization of 9-vinylanthracene, 12:37433 (J;US)

**VISCOSIMETERS**
Vacuum still bottoms viscometer, 12:36289 (B;US)

**VISCOUS FLOW**
**Mathematical Models**
Modeling the viscous wall region, 12:38107 (J;US)

**VISIBLE RADIATION**
**Pulses**
The group velocity of short optical pulses, 12:38318 (BA;US)
**Wave Propagation**
Light and group theory, 12:38228 (BA;US)
The group velocity of short optical pulses, 12:38318 (BA;US)

**VISITOR CENTERS**
*See PUBLIC BUILDINGS*

**VITAMIN A**
**Structure-Activity Relationships**
Time-resolved laser studies on the proton pump mechanism of bacteriorhodopsin: Progress report, December 1, 1984-November 30, 1987, 12:36640 (R;US)

**VITRIFICATION**
**Quality Assurance**
Statistical process control: An approach to quality assurance in the production of vitrified nuclear waste, 12:36528 (R;US)

**VOIDS**
**Detection**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**Sizing**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
Surface roughness effects in porosity assessment by ultrasonic attenuation spectroscopy, 12:37263 (BA;US)
**Wave Propagation**
Effect of nonspherical pores and multiple scattering on the ultrasonic characterization of porosity, 12:37262 (BA;US)
Ultrasonic attenuation measurement by backscattering analysis, 12:37365 (BA;US)
**VOLATILE MATTER**
**Air Pollution Control**
VOC (volatile organic compounds) emissions from volatile organic liquid storage tanks-background information for promulgated standards. Final environmental impact statement, 12:37679 (R;US)
**Air Pollution Monitoring**
Precolumn sample-enrichment device for analysis of ambient volatile organics by gas chromatography-mass spectrometry, 12:37636 (R;US)
**Control**
Chemistry of oxidant formation: implications for designing effective control strategies, 12:37655 (R;US)
**Indoor Air Pollution**
Control-technology assessment for coal gasification and liquefaction processes, 12:36275 (R;US)
Health-hazard evaluation report HETA-82-059-1752, Art Academy of Cincinnati, Cincinnati, Ohio, 12:37693 (R;US)
**VOLCANOES**
**Ashes**
Mount St. Helens: the aftermath, 12:37673 (R;US)
**Environmental Effects**
Development of old-growth Douglas-fir forests northeast of Mount St. Helens, Washington, following an A.D. 1480 eruption, 12:37750 (RA;US)
**VOLTAIC CELLS**
*See ELECTRIC BATTERIES*
**VOLTAMETRY**
**Data Analysis**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**Parametric Analysis**
Electrochemical characterization and derivatization of coal: Technical progress report, March 15, 1987-June 15, 1987, 12:36319 (R;US)
**VOLT-AMPERE CHARACTERISTIC**
*See ELECTRIC CONDUCTIVITY*
**VORTICES (MAGNETIC)**
*See MAGNETIC FLUX*
**VULCAIN EXPERIMENT NUCLEAR STUDY**
*See VENUS REACTOR*

## W

**W MINUS BOSONS**
*Prior to October 1985 this concept was indexed to INTERMEDIATE VECTOR BOSONS.*
**Leptonic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**Particle Production**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Weak Hadronic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**W PLUS BOSONS**
*Prior to October 1985 this concept was indexed to INTERMEDIATE VECTOR BOSONS.*
**Leptonic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**Particle Production**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Weak Hadronic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
**WALLS**
**Thermal Conduction**
Conduction of heat from a planar wall with uniform surface temperature to a monodispersed suspension of spheres, 12:37503 (J;US)
**Thermal Insulation**
Retrofit wall insulation study, 12:37039 (RA;US)
**Thickness**
Reduced girth seam weldments for heavy-walled vessels, 12:36249 (RA;US)
**WANKEL ENGINES**
**Reviews**
Automobile engines. Design and function, 12:37163 (R;DE;In German)
**WARFARE**
*See also CHEMICAL WARFARE*
**Computerized Simulation**
A study of Economy of Force: An analysis of varying the size of a main and secondary taskforce against a dynamic defense, 12:38400 (R;US)
**Functional Models**
Transition to deterrence based on strategic defense, 12:37191 (J;US)
**Nuclear Deterrence**
Avoiding war with the Soviet Union, 12:37192 (J;US)
**Nuclear Weapons**
Command and control of the US heavy division on the nuclear battlefield, 12:37588 (R;US)
Tactical encirclement reductions, 12:37589 (R;US)
**WASTE BURIAL**
*See UNDERGROUND DISPOSAL*
**WASTE DISPOSAL**
*See also GROUND DISPOSAL*
*MARINE DISPOSAL*
*RADIOACTIVE WASTE DISPOSAL*
*SANITARY LANDFILLS*
*UNDERGROUND DISPOSAL*
**Environmental Impacts**
Environmental problems involved in the disposal of fly ash from waste incineration on waste dumps. Summaries, 12:37807 (R;DE;In German)
**Ground Disposal**
Superfund federal-lead remedial project-management handbook. Final report, 12:37812 (R;US)
Superfund state-lead remedial project-management handbook. Final report, 12:37813 (R;US)
**Land Pollution**
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)
**Sanitary Landfills**
Minimum-technology guidance on single-liner systems for landfills, surface impoundments, and waste piles - design, construction, and operation. Draft report 1982-85, 12:37809 (R;US)
Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)
**Site Selection**
Superfund innovative technology evaluation (site) strategy and program plan, 12:37811 (R;US)

**Water Pollution Monitors**
Health and Safety Program for ground-water investigations at 39 waste management sites within the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, 12:36518 (R;US)

**WASTE ISOLATION PILOT PLANT**
*See WIPP*

**WASTE MANAGEMENT**
*See also RADIOACTIVE WASTE MANAGEMENT*
*WASTE DISPOSAL*
*WASTE PROCESSING*
*WASTE TRANSPORTATION*
**Surveys**
Hazardous-waste staff-assistance survey, Patrick AFB and Cape Canaveral AFS, Florida. Final report, 4 July-9 December 1986, 12:36957 (R;US)
**Technology Assessment**
DOE Hazardous Waste Remedial Actions Program: Annual report, FY 1986, 12:36959 (R;US)
**Technology Utilization**
Annual report to the Congress, Fiscal Year 1986 (Office of Technology Assessment), 12:36973 (R;US)

**WASTE PROCESSING**
*See also ANAEROBIC DIGESTION*
*MATERIALS RECOVERY*
*RADIOACTIVE WASTE PROCESSING*
**Technology Utilization**
Superfund treatment technologies: a vendor inventory, 12:37814 (R;US)

**WASTE PROCESSING PLANTS**
**Pyrolysis**
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)
**Waste Heat Utilization**
Construction and testing of a pyrolysis plant for disposal of special wastes with recovery of raw materials and energy. Final report, 12:37521 (R;DE;In German)

**WASTE PRODUCT UTILIZATION**
Recovery and reuse of asphalt roofing waste: recycling roofing waste to new roofing, 12:37139 (R;US)

**WASTE TRANSPORTATION**
**Planning**
Developing a national system for transporting high-level nuclear waste, 12:36495 (BA;US)
**Transportation Systems**
Developing a national system for transporting high-level nuclear waste, 12:36495 (BA;US)

**WASTE TREATMENT**
*See WASTE PROCESSING*

**WASTE WATER**
**Fermentation**
Utilization of solid matter and the saving of energy within the sphere of the sugar industry by means of the biotechnical use of extracted cossettes - Phase 2. Final report, 12:36596 (R;DE;In German)
**Health Hazards**
Health-hazard evaluation report HETA 85-441-1765, New Boston Coke Corporation, New Boston, Ohio, 12:36291 (R;US)
**Purification**
Characterization, renovation, and utilization of water from slurry-transport systems, 12:36348 (R;US)
**Qualitative Chemical Analysis**
Separation and detection of ammonia, amines, and alkanolamines with single-column ion chromatography, 12:36474 (R;US)
**Quantitative Chemical Analysis**
Organic solute profile of water from Rio Blanco Retort 1, 12:36473 (R;US)
**Radioactivity**
Radioactivity in coal, ashes and selected wastewaters from Canadian coal-fired steam electric generating stations, 12:37849 (R;CA)
**Water Treatment**
Anaerobic fluid-bed treatment of coal conversion wastewater: Third quarterly technical progress report for the period February 16-May 15, 1987, 12:36327 (R;US)
Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)
Testing to determine relationship between explosive-contaminated sludge components and reactivity. Final report, June 1985-January 1987, 12:37837 (R;US)
**Water Treatment Plants**
Treatment of landfill leachate at publicly owned treatment works, 12:37815 (R;US)

**WASTE-FUELED BOILERS**
*See REFUSE-FUELED BOILERS*

**WASTES**
*See also GASEOUS WASTES*
*INDUSTRIAL WASTES*
*MUNICIPAL WASTES*
*ORGANIC WASTES*
*RADIOACTIVE WASTES*
*SOLID WASTES*
**Combustion**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)
**Gasification**
Trace metal removal from combustion gases, 12:36335 (R;FI;In Finnish)

**WATER**
*See also GROUND WATER*
*WASTE WATER*
**Biological Availability**
Regeneration of baldcypress (Taxodium distichum (L.) Rich.) as related to drought in the LaBranche wetlands of Southern Louisiana, 12:38021 (RA;US)
White alder growth and development: the effect of small hydroelectric projects in the Sierra Nevada of California (Alnus rhombifolia), 12:36616 (RA;US)
**Biological Effects**
Interaction of $H_2O$ and nitrogen stresses on trees: Progress report, 1 October 1986 to 30 September 1987, 12:36627 (R;US)
**Consumption Rates**
Water jet/jet assisted cutting and drilling, 12:36340 (R;GB)
**Desalination**
Simultaneous production of desalinated water and power using a hybrid-cycle OTEC plant, 12:36678 (J;US)
**Electrolysis**
Pilot scale (100 kW) water electrolysis plant based on inorganic-membrane-electrolyte technology. Final report, 12:36575 (R;DE)
**Equations of State**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)
**Excitation**
Nonlinear-spectroscopic studies of highly excited states of molecules in supersonic beams, 12:38096 (R;US)
**Photolysis**
Photochemical dissociation of water: Development and study of new heterogeneous catalysts. Final report, 12:36576 (R;DE)
**Quantitative Chemical Analysis**
Application of XAD-4 solid sorbent and HPLC [high performance liquid chromatography] with electrochemical detection to the analysis of phenols in water: Final report, November 1983-November 1985, 12:37377 (R;US)
**Solubility**
Mutual solubilities in six binary mixtures of water + a heavy hydrocarbon or a derivative, 12:37418 (J;US)
**Vapor Pressure**
Temperature-dependent parameters and the Peng-Robinson equation of state, 12:37413 (J;US)

**WATER CONTENT**
*See MOISTURE*

**WATER COOLANT**
*See WATER*

**WATER HEATERS**
*See also SOLAR WATER HEATERS*
**Energy Efficiency**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)
**Market**
Energy efficiency choice in the purchase of residential appliances, 12:37097 (BA;US)

**Performance Testing**
Domestic hot water service in Lumley homes: a comparison of energy audit diagnosis with instrumented analysis, 12:37033 (RA;US)

**WATER HEATING**
**Energy Efficiency**
Conversion from central to apartment-level heating in multifamily buildings: the Asbury Park Village case study, 12:37035 (RA;US)
Domestic hot water service in Lumley homes: a comparison of energy audit diagnosis with instrumented analysis, 12:37033 (RA;US)
Results of detailed monitoring of one of the energy resource center's multifamily shared savings buildings, 12:37049 (RA;US)

**WATER MODERATOR**
*See WATER*

**WATER POLLUTION**
Long term effects of oil on marine benthic communities in enclosures (Norway), 12:36420 (R;NO)
**Bibliographies**
EPA (Environmental Protection Agency) Publications Bibliography. Quarterly abstract bulletin. Quarterly report, 12:36968 (R;US)
**Institutional Factors**
Fence: where the community and the workplace meet, 12:37889 (R;US)
**Manuals**
Environmental Assessment Technical Assistance Handbook, 12:36964 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)
**Surveys**
National Surface Water Survey: Western Lake Survey-Phase 1 (synoptic chemistry) field operations report, 12:37844 (R;US)

**WATER PUMPS**
**Photovoltaic Power Supplies**
Water pumping: The solar alternative, 12:36648 (R;US)

**WATER QUALITY**
**Agreements**
Great Lakes water-quality agreement: an evolving instrument for ecosystem management. Final report, 12:37845 (R;US)
**Mathematical Models**
Water-quality-modeling software available from US EPA (Environmental Protection Agency), 12:37839 (R;US)
**Monitoring**
Aquatic environmental conditions in Chickamauga Reservoir during operation of Sequoyah Nuclear Plant: Fourth annual report, 1984, 12:37856 (R;US)
**Pollution Sources**
Water-quality-modeling software available from US EPA (Environmental Protection Agency), 12:37839 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) research program guide, FY 1987, October 1, 1986-September 30, 1987, 12:36965 (R;US)

**WATER RESERVOIRS**
**Computerized Simulation**
Model with two reservoirs used in a multisystem model, 12:36609 (R;NO;In Norwegian)
**Fishes**
Concentrations of PCBs, DDTr, and metals in fish from Tellico Reservoir, 12:37846 (R;US)

**WATER RESOURCES**
**Reliability**
Strategies for coping with drought: Part 2, Planning techniques and reliability assessment: Final report, 12:36610 (R;US)
**Water Treatment**
Co-production of gas and water, fifth year. Annual report, August 1985-July 1986, 12:36439 (R;US)

**WATER RIGHTS**
**Legal Aspects**
Assessment of selected legal/institutional constraints to water conservation in the western states, 12:36969 (R;US)

**WATER TREATMENT**
**Economic Analysis**
Estimates of wastewater-treatment capital requirements in rural America. Staff report, 12:36970 (R;US)

**WATER WELLS**
**Radiation Monitoring**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)
**Radioactivity**
Source of gross-alpha radioactivity anomalies in recharge wells, central Florida phosphate district. Final report, 12:37851 (R;US)

**WATERBORNE PARTICLES**
*See PARTICULATES*

**WATERFLOODING**
*See also CAUSTIC FLOODING*
**Additives**
Investigations of biopolymer degradation in aqueous solutions with a view to applications in enhanced petroleum recovery, 12:36386 (R;DE;In German)
**Simulators**
Modelling and scale-up of chemical flooding: First annual report for the period October 1985-September 1986, 12:36379 (R;US)

**WATERSHEDS**
**Input-Output Analysis**
The role of dry deposition in acidification of waters, 12:37767 (R;US)

**WAVE EQUATIONS**
**Computer Architecture**
Architectural implications of a parallel-computational approach to the vector-wave equation. Master's thesis, 12:38307 (R;US)

**WAVE PROPAGATION**
**Mathematical Models**
Modeling of ICRH experiments in the Tara tandem mirror, 12:38327 (R;US)

**WAVES (SHOCK)**
*See SHOCK WAVES*

**WAZ 16**
*See NICKEL BASE ALLOYS*

**WEAK BOSON**
*See INTERMEDIATE VECTOR BOSONS*

**WEATHER**
**Variations**
Time-dependent responses of trees to weather variations an application of the Kalman filter, 12:37954 (RA;US)

**WEATHERIZATION**
Weatherization assistance program: Final monitoring report for Arizona; California; the Navajo Nation; Nevada, 12:37067 (R;US)
**Program Management**
State of Minnesota high level weatherization project, 12:37057 (RA;US)

**WECS**
*See WIND TURBINES*

**WEINBERG ANGLE**
**Radiative Corrections**
Electroweak radiative corrections and neutral current phenomenology, 12:38112 (R;US)

**WEINBERG-SALAM GAUGE MODEL**
CEBAF [Continuous Electron Beam Accelerator Facility] scientific program, 12:38230 (R;US)
**Neutrinos**
Neutrino emission by the pair, plasma, and photo processes in the Weinberg-Salam model, 12:38205 (J;US)
**Quarks**
Status of electroweak theory for heavy quark decays and CP violation, 12:38209 (BA;DE)

**WELDED JOINTS**
**Acoustic Microscopy**
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)

**Crack Propagation**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Grain Size**
Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
**Image Processing**
Ultrasonic detection of weld bead geometry, 12:37270 (BA;US)
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**Inspection**
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Microstructure**
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)
**Oxidation**
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
**Seismic Effects**
Seismic verification of nuclear plant equipment anchorage: Volume 1, Development of anchorage guidelines: Final report, 12:36827 (R;US)
Seismic verification of nuclear plant equipment anchorage: Volume 2, Anchorage inspection workbook: Final report, 12:36828 (R;US)
**Stress Corrosion**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
**Ultrasonic Testing**
Origin of spurious ultrasonic echoes in stainless steel piping with weld overlay, 12:36775 (BA;US)
Ultrasonic detection of weld bead geometry, 12:37270 (BA;US)
Ultrasonic NDE of tubing pinch welds, 12:37271 (BA;US)
Ultrasonic evaluation and imaging of tube closure welds, 12:37272 (BA;US)
Ultrasonic NDE of integrally fabricated turbine rotors, 12:37273 (BA;US)

**WELDING**
*See also ARC WELDING*
**Hazardous Materials**
Health-hazard evaluation report HETA 85-018-1759, American Crystal Sugar Company, Moorhead, Minnesota, 12:37695 (R;US)

**WELDING MACHINES**
**Performance Testing**
Ultrasonic detection of weld bead geometry, 12:37270 (BA;US)

**WELDS**
*See WELDED JOINTS*

**WELL DRILLING**
**Meetings**
Investigation of the structure of filter cakes from bore flushing. Investigation of temperature stability of bore flushing liquids based on water. Investigation of rock drilling processes with diamond cutters of peg shape, 12:36375 (R;DE;In German)

**WELL LOGGING EQUIPMENT**
*To be used only when the equipment itself is the topic of the paper; includes source, detector, and associated equipment.*
**Computers**
Advances in borehole seismic fracture diagnostics, 12:36403 (BA;US)

**WELLS**
*See also GAS CONDENSATE WELLS*
*GEOTHERMAL WELLS*
*INJECTION WELLS*
*NATURAL GAS WELLS*
*OIL WELLS*
*WATER WELLS*
**Flowmeters**
Process control methodologies for advanced fossil energy process research, 12:36258 (RA;US)

**WEST GERMANY**
*See FEDERAL REPUBLIC OF GERMANY*

**WEST VIRGINIA**
**Natural Gas Fields**
Devonian shale horizontal well: Rationale for wellsite selection and well design, 12:36451 (BA;US)

**WESTERN EUROPE**
*See also AUSTRIA*
*FEDERAL REPUBLIC OF GERMANY*
*ICELAND*
*ITALY*
*SWITZERLAND*
*UNITED KINGDOM*
**Natural Gas Fields**
Gas recovery from deep millidarcy layered gas formations with nonlinear elastic deformation characteristics, 12:36443 (BA;US)
Hydraulic fracture treatment design simulation for the Rotliegendes formation, 12:36449 (BA;US)
**Petroleum Industry**
Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)
**Pipelines**
Methods of prevention, detection, and control of spillages in west European oil pipelines, 12:36425 (R;NL)

**WESTINGHOUSE STANDARD REACTOR**
*Prior to 1975, PWR/41 TYPE REACTORS was used.*
**Heat Transfer**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**Hydraulics**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
**Loss of Coolant**
Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)
**Reactor Safety**
Evaluation of scaling concepts for integral system test facilities, 12:36841 (RA;US)
Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)
**Test Facilities**
Results of 5% small-break LOCA tests and natural circulation tests at the ROSA-IV LSTF, 12:36848 (RA;US)

**WETLANDS**
**Environmental Impacts**
EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)
**Hydrology**
Cypress tree-ring analysis in relation to wetlands and hydrology, 12:37832 (RA;US)
Hydrogeological studies of peatlands at Haerjedalen, 12:36345 (R;SE;In Swedish)
**Land Reclamation**
Studies of a method of wetland reconstruction following phosphate mining. Final report, 12:37827 (R;US)
**Research Programs**
EPA (Environmental Protection Agency) adopts wetlands research plan, 12:37688 (R;US)

**WETTING HEAT**
**Correlations**
Immersion calorimetry of fine coal particles and its relation to flotation, 12:36293 (R;US)
**Measuring Methods**
An experimental study of heat of immersion of coal, 12:36292 (R;US)

**WHALES**
*See CETACEANS*

**WHITE DWARF STARS**
**Star Accretion**
X-ray and ultraviolet radiation from accreting white dwarfs. IV. Two-temperature treatment with electron thermal conduction, 12:38074 (J;US)
**X Radiation**
X-ray and ultraviolet radiation from accreting white dwarfs. IV. Two-temperature treatment with electron thermal conduction, 12:38074 (J;US)

**WIGGLER MAGNETS**
**Computer-Aided Design**
A high gain free electron laser amplifier design for the Alcator-C tokamak, 12:37518 (R;US)
**F Codes**
A high gain free electron laser amplifier design for the Alcator-C tokamak, 12:37518 (R;US)

**Performance**
Free-electron laser success explained, 12:37492 (J;US)
**WIGNER DISTRIBUTION**
Electronic properties of two-dimensional systems in sub-micron devices: Final report, September 1, 1985-November 30, 1986, 12:38297 (R;US)
**WILD ANIMALS**
**Habitat**
Wild-life studies in the Alta watercourse. Survey report for 1982-1984 (Finnmark, Norway), 12:37766 (R;NO;In Norwegian)
**Population Dynamics**
Wild-life studies in the Alta watercourse. Survey report for 1982-1984 (Finnmark, Norway), 12:37766 (R;NO;In Norwegian)
**WILDERNESS AREAS**
*See NATURE RESERVES*
**WILLOWS**
**Mortality**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**Plant Growth**
Determination of bank widening and accretion rates and vegetation recovery along modified West Tennessee streams, 12:37830 (RA;US)
**Population Dynamics**
Relative importance of snow avalanche disturbance and thinning on tree populations, 12:37749 (RA;US)
**WIND**
**Computerized Simulation**
VAWT stochastic wind simulator, 12:36742 (R;US)
**Site Surveys**
Improving the performance of mass-consistent numerical models using optimization techniques, 12:36736 (J;US)
**Turbulent Flow**
Numerical calculation of turbulent flow around a cubic element, 12:37498 (R;DE;In German)
**V Codes**
VAWT stochastic wind simulator, 12:36742 (R;US)
**WIND ENERGY CONVERSION SYSTEMS**
*See WIND TURBINES*
**WIND GENERATORS**
*See ELECTRIC GENERATORS*
*WIND TURBINES*
**WIND POWER**
**Resource Potential**
Wind energy resource survey of New Zealand: Phase 1, National survey using existing data: Detailed technical report, 12:36735 (R;NZ)
**WIND POWER PLANTS**
**Performance**
Electrical behavior of wind power stations: Final report, 12:36646 (R;US)
**Power Generation**
Electrical behavior of wind power stations: Final report, 12:36646 (R;US)
**Power Supplies**
Measurements of power quality for a modern wind turbine, 12:36743 (R;DK;In Danish)
**WIND TURBINES**
*See also VERTICAL AXIS TURBINES*
**Acoustic Monitoring**
Noise prediction programme for wind turbines, 12:36738 (R;GB)
**Aerodynamics**
Empirical model for near-to far-field wakes behind a smooth cylindrical pole tower, 12:36748 (BA;US)
**Aesthetics**
First report on the visual impact of large wind turbines, 12:36737 (R;GB)
**Computer Calculations**
Adaptive pitch control of a 25m wind turbine generator, 12:36740 (R;GB)
**Computerized Simulation**
Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis, 12:36739 (R;GB)
**Control Systems**
Adaptive pitch control of a 25m wind turbine generator, 12:36740 (R;GB)
**Darrieus Rotors**
Construction and testing of a Darrieus wind turbine. Demonstration plant, 12:36741 (R;DK;In Danish)
**Design**
First report on the visual impact of large wind turbines, 12:36737 (R;GB)
**Diesel Engines**
Reliability aspects of wind/diesel hybrid generating systems, 12:36749 (BA;US)
**Electric Generators**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
**Flow Models**
Empirical model for near-to far-field wakes behind a smooth cylindrical pole tower, 12:36748 (BA;US)
**Hybrid Systems**
Reliability aspects of wind/diesel hybrid generating systems, 12:36749 (BA;US)
**Hydraulic Equipment**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)
**Mechanical Transmissions**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 2, 12:36745 (R;GB)
**Noise**
Noise prediction programme for wind turbines, 12:36738 (R;GB)
**Parametric Analysis**
Assessment of the dependence of wind turbine generator design upon meteorological parameters. Final report on frequency domain analysis, 12:36739 (R;GB)
**Performance Testing**
Empirical model for near-to far-field wakes behind a smooth cylindrical pole tower, 12:36748 (BA;US)
**Reliability**
Reliability aspects of wind/diesel hybrid generating systems, 12:36749 (BA;US)
**Spectral Response**
Noise prediction programme for wind turbines, 12:36738 (R;GB)
**Transmission**
Comparison of mechanical and hydraulic transmission systems for aerogenerators. Volume 1, 12:36744 (R;GB)
**WINDOWS**
*See also STORM WINDOWS*
**Diffuse Solar Radiation**
Measurement of single and double glazing thermal performance under realistic conditions using the mobile window thermal test (MoWiTT) facility, 12:37096 (BA;US)
**Glazing**
Measurement of single and double glazing thermal performance under realistic conditions using the mobile window thermal test (MoWiTT) facility, 12:37096 (BA;US)
**Glazing Materials**
Recent results: SERI's development of advanced glazings, 12:37054 (RA;US)
**Thermal Efficiency**
Measurement of single and double glazing thermal performance under realistic conditions using the mobile window thermal test (MoWiTT) facility, 12:37096 (BA;US)
**WINSTON COLLECTORS**
*See COMPOUND PARABOLIC CONCENTRATORS*
**WIPP**
**Permeability**
Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986, 12:36540 (R;US)
**Site Surveys**
Summary of and observations about WIPP [Waste Isolation Pilot Plant] Facility horizon flow measurements through 1986, 12:36540 (R;US)

**WISCONSIN**
**Paleoclimatology**
Late Glacial reforestation in the Swiss mittelland and in Wisconsin illustrated by the Daettnau and the Two Creeks buried forests, 12:38024 (RA;US)
**WOLFRAM**
*See TUNGSTEN*
**WOOD**
**Chemical Analysis**
Trace element analysis of wood, a tool for monitoring air pollution, 12:37796 (RA;DE)
**Combustion Products**
Wood crib fires in a ventilated tunnel. Report of Investigations/1986, 12:36366 (R;US)
**Cross Sections**
Method to obtain thin cross-sections for tree-ring analysis, 12:38036 (RA;US)
**Density**
Direct reading x-ray densitometer, 12:38031 (RA;US)
**WOOD ALCOHOL**
*See METHANOL*
**WOOD FUELS**
*Use of this term is limited to policy, feasibility, and socio-economic studies. For wood properties use WOOD.*
**Pyrolysis**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
**WOOD WASTES**
**Combustion Products**
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 1. Technical results. Final report, March 1981-March 1984, 12:36606 (R;US)
Environmental assessment of a wood-waste-fired industrial watertube boiler. Volume 2. Data supplement. Final report, March 1981-March 1984, 12:36607 (R;US)
**Pyrolysis**
Flash pyrolysis of peat, wood, bark and lignin. Part 1. A state-of-the-art study and an assessment of possibilities for industrial application, 12:36278 (R;FI;In Finnish)
**WORKERS**
*See PERSONNEL*
**WORKING CONDITIONS**
**Air Quality**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
**Office Buildings**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Personnel**
Effects of different heating and ventilation systems on employees in relation to symptoms and general comfort in an office building, 12:37083 (R;FI;In Finnish)
**Thermal Comfort**
Air conditioning at the working positions in an open plan office, 12:37087 (R;FI;In Finnish)
**WYOMING**
**Green River Formation**
Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)
**Natural Gas Deposits**
Quantitative model of overpressured gas resources of the Pinedale anticline, Wyoming, 12:36431 (BA;US)

## X

**X CODES**
An experimental measurement of metal multilayer x-ray reflectivity degradation due to intense x-ray flux, 12:38298 (R;US)
**XENOBIOTICS**
**Metabolism**
Distribution of xenobiotic metabolizing enzymes in respiratory tract of Beagle dogs, 12:37977 (RA;US)
Isolation and characterization of cytochrome P-450 isozymes from mouse liver, 12:37978 (RA;US)
Nasal metabolism of benzo[a]pyrene and dihydrosafrole in Beagle dogs and nonhuman primates, 12:37979 (RA;US)
**Toxicity**
Distribution of microsomal monooxygenases in the rabbit respiratory tract, 12:37976 (RA;US)
**XENON 132 TARGET**
**Pion Minus Reactions**
Observation of $\pi$/sup 0/$\pi$/sup 0/-interference effect and size of neutral pion emission volume in $\pi$/sup -/Xe-interactions at 3.5 GeV/c, 12:38255 (TG;DE)
**XI-2030 RESONANCES**
**Particle Production**
J/psi spectroscopy from MARK III, 12:38139 (RA;US)
**X-RASERS**
*See X-RAY LASERS*
**X-RAY LASERS**
**Technology Assessment**
X-ray laser world wide progress, 12:37488 (R;US)
**X-RAY SPECTROMETERS**
**Design**
High-pressure duo-multichannel soft x-ray spectrometer for tokamak plasma diagnostics, 12:38347 (R;US)
**Performance Testing**
Normal incidence x-ray telescope. Semiannual progress report, 1 May 1985-31 October 1986, 12:37566 (R;US)
**XYLENES**
**Hydrometallurgy**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Solvent Extraction**
Analysis of liquid extraction for hydrometallurgical systems: Iron (III) sulfate-$\beta$-alkenyl-8-hydroxyquinoline/xylene system, 12:37424 (J;US)
**Solvent Properties**
Solubilities of higher normal alkanes in m-xylene, 12:37417 (J;US)
**XYLOSE**
**Decomposition**
Formation of aromatic compounds from carbohydrates: 10, Reaction of xylose, glucose, and glucuronic acid in acidic solution at 300°C, 12:37406 (R;US)
**Fermentation**
SERI Biochemical Conversion Program: 1985 annual report, 12:36601 (R;US)

## Y

**Y-12 PLANT**
**Environment**
F-Area Seepage Basins: Environmental information document, 12:37826 (R;US)
**Geology**
Subsurface-controlled geological maps for the Y-12 plant and adjacent areas of Bear Creek Valley, 12:38039 (R;US)
**YIELD (BIOLOGICAL)**
*See PRODUCTIVITY*
**YOUNG MODULUS**
**Experimental Data**
Mechanical properties and consolidation of potential DHLW [Defense High-Level Wastes] backfill materials: Crushed salt and 70/30 bentonite/sand (Crushed salt: bentonite = 70:30 by weight), 12:36535 (R;US)
**YTTRIUM 89**
**Energy Levels**
Microscopic distorted-wave approximation study of low-energy nucleon scattering from /sup 89/Y, 12:38246 (J;US)

**YTTRIUM 89 TARGET**
**Hypernuclei**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**Neutron Reactions**
Microscopic distorted-wave approximation study of low-energy nucleon scattering from /sup 89/Y, 12:38246 (J;US)
**Pion Plus Reactions**
Studies of hypernuclei by associated production, 12:38237 (R;US)
**YTTRIUM 90**
**Metabolism**
Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII, 12:37912 (RA;US)
**Toxicity**
Toxicity of $^{90}Y$ in a relatively insoluble form inhaled by Beagle dogs. XVIII, 12:37911 (RA;US)
Toxicity of $^{91}Y$ inhaled in a relative insoluble form by beagle dogs. XVII, 12:37912 (RA;US)
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)
**YTTRIUM 91**
**Toxicity**
Toxicity studies of inhaled beta-emitting radionuclides - status report, 12:37908 (RA;US)
**YTTRIUM ALUMINIUM GARNETS**
*See ALUMINIUM OXIDES*
*YTTRIUM COMPOUNDS*
**YTTRIUM COMPOUNDS**
*See also YTTRIUM OXIDES*
**Crystal Structure**
YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)
**YTTRIUM OXIDES**
**Corrosion Resistance**
Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)
**Microstructure**
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
**Superconductivity**
Critical performance of ceramic processed $YBa_2Cu_3O_7$ materials, 12:37287 (R;US)
Electron microscopy of high temperature oxide superconductors, 12:37290 (R;US)
Magnetization studies of the high T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/, 12:37294 (R;US)
Switching phenomena in a new 90-K superconductor, 12:37359 (J;GB)
Transport critical-current characteristics of $Y_1Ba_2Cu_3O$/sub x/, 12:37288 (R;US)
**YUCCA MOUNTAIN**
**Geology**
Status of geologic investigations for nuclear waste disposal at the Nevada Test Site, 12:36509 (RA;US)
**Hydrology**
Infiltration at Yucca Mountain, Nevada, traced by $^{36}Cl$ (NNWSI), 12:36520 (R;US)
Status of geologic investigations for nuclear waste disposal at the Nevada Test Site, 12:36509 (RA;US)

## Z

**Z NEUTRAL BOSONS**
*Prior to October 1985 this concept was indexed to INTERMEDIATE VECTOR BOSONS.*
**Leptonic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
Search for new interactions via lepton flavor violation at or beyond the $Z^0$ pole., 12:38174 (RA;US)
**Mass**
Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)
Report on electroweak parameters, 12:38171 (RA;US)
Status report on the polarization facility at the SLC, 12:38173 (RA;US)
Study of QED radiative corrections at the Z, 12:38168 (RA;US)
**Particle Production**
Latest results from the UA2 experiment, 12:38132 (RA;US)
Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)
Renormalization group improved Yennie-Frautschi-Suura Theory and Monte Carlo event generators, 12:38169 (RA;US)
Report on electroweak parameters, 12:38171 (RA;US)
Search for new interactions via lepton flavor violation at or beyond the $Z^0$ pole., 12:38174 (RA;US)
Status report on the polarization facility at the SLC, 12:38173 (RA;US)
Study of QED radiative corrections at the Z, 12:38168 (RA;US)
Toponium-$Z^0$ mixing, 12:38192 (RA;US)
**Particle Properties**
Electroweak interactions - standard and beyond, 12:38190 (RA;US)
**Particle Widths**
Physics from $Z^0$ measurements: mass, width, and total cross section, 12:38166 (RA;US)
Study of QED radiative corrections at the Z, 12:38168 (RA;US)
**Standard Model**
$E^+e^- \rightarrow W^+W^-$ in $E_6$ models with additional neutral gauge bosons, 12:38199 (J;US)
**Weak Hadronic Decay**
Latest results from the UA2 experiment, 12:38132 (RA;US)
Search for flavor-changing neutral currents at the $Z^0$, 12:38165 (RA;US)
**Z PINCH DEVICES (LINEAR)**
*See LINEAR Z PINCH DEVICES*
**ZEOLITES**
**Catalytic Effects**
Catalytic and physicochemical properties of zeolites with geometrical selectivity, 12:36409 (R;FR;In French)
**Sorptive Properties**
Evaluation of silver mordenite for radioiodine retention at the PUREX Process Facility Modification, 12:36489 (R;US)
**ZINC**
**Corrosion**
Effects of sheltering and orientation on the atmospheric corrosion of structural metals, 12:37634 (R;US)
**Emission**
Zinc/zinc oxide preliminary source assessment, 12:37690 (R;US)
**Uptake**
Uptake and distribution of heavy metals in annelidae, with particular regard to limnic tubificides (oligochaeta), 12:37987 (R;DE;In German)
**Water Pollution**
Effects of contaminants on naiad mollusks (Unionidae): a review, 12:38000 (R;US)
**ZINC OXIDES**
**Catalytic Effects**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**Emission**
Zinc/zinc oxide preliminary source assessment, 12:37690 (R;US)
**Surface Properties**
Solid state, surface and catalytic properties of oxides: Final report, 12:37392 (R;US)
**ZINC PHOSPHIDES**
**Crystal Structure**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**Electronic Structure**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**Photoconductivity**
Metal site disorder in zinc tin phosphide, 12:37356 (J;US)
**ZINC-BROMINE BATTERIES**
Zinc-bromine battery development, 12:36946 (R;US)

**ZION STATION UNIT-1**
*See ZION-1 REACTOR*
**ZION STATION UNIT-2**
*See ZION-2 REACTOR*
**ZION-1 REACTOR**
*Zion, Illinois, USA*
**Containment Systems**
DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
**Pipes**
Sensitivity of piping seismic responses to input factors, 12:36931 (R;US)
**Reactor Components**
Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
**Reactor Safety**
DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
Sensitivity of piping seismic responses to input factors, 12:36931 (R;US)
**Risk Assessment**
Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
**Seismic Effects**
Importance and sensitivity of parameters affecting the Zion Seismic Risk, 12:36932 (R;US)
Sensitivity of piping seismic responses to input factors, 12:36931 (R;US)
**ZION-2 REACTOR**
*Zion, Illinois, USA*
**Containment Systems**
DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
**Reactor Safety**
DCH-1: first direct containment heating experiment in the SURTSEY test facility, 12:36910 (RA;US)
**ZIRCALOY 2**
**Fuel Cans**
Automated system for assessing the cladding thickness and bond integrity of tubular nuclear fuel elements, 12:36810 (R;US)
**ZIRCONIUM**
**Deposition**
Laser cladding of Mg and Nb alloys for improved environmental resistance. Annual report, January 1986-January 1987, 12:37201 (R;US)
**ZIRCONIUM COMPOUNDS**
*See also ZIRCONIUM OXIDES*
**Crystal Structure**
YPt/sub 2/In and other compounds of the ZrPt/sub 2/Al-type, 12:37360 (J;US)
**Hydrolysis**
Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
**Ionic Conductivity**
Copper ion-conducting materials in chloride melts, 12:36943 (R;DK;In Danish)
**ZIRCONIUM ISOTOPES**
**Excited States**
Observation of full sets of coexisting intruder excitations in the N=58 isotones and isotopes of Zr: Evidence for alpha correlated excitations, 12:38256 (BA;DE)
**ZIRCONIUM OXIDES**
Thermal-shock resistance of mullite-based SiC-whisker composites. Master's thesis, 12:37326 (R;US)
**Chemical Preparation**
Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
Preparation of Al/sub 2/O/sub 3/-ZrO/sub 2/ composites by adjustment of surface chemical behavior, 12:37308 (BA;US)
**Corrosion Resistance**
Ceramic thermal barrier coatings with improved corrosion resistance, 12:37303 (R;US)
**Crystal Growth**
Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
**Mechanical Properties**
Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Nucleation**
Nucleation and growth of uniform m-ZRO/sub 2/, 12:37315 (BA;US)
**Perturbed Angular Correlation**
Zirconia characterization by perturbed angular correlation spectroscopy, 12:37320 (BA;US)
**Phase Transformations**
Transformation toughening of ceramics. Annual report No. 1, 1 September 1985-31 August 1986, 12:37278 (R;US)
**Spectroscopy**
Zirconia characterization by perturbed angular correlation spectroscopy, 12:37320 (BA;US)
**Structural Chemical Analysis**
Zirconia characterization by perturbed angular correlation spectroscopy, 12:37320 (BA;US)
**ZT-40 DEVICES**
**Operation**
Pellet injection on the ZT-40M reversed field pinch, 12:38386 (J;US)
**Pellet Injection**
Pellet injection on the ZT-40M reversed field pinch, 12:38386 (J;US)
**ZYMOMONAS MOBILIS**
**DNA Sequencing**
Promoter and nucleotide sequences of the Zymomonas mobilis pyruvate decarboxylase, 12:37867 (J;US)

# CONTRACT NUMBER INDEX

Numbers assigned to DOE contracts under which documents announced in this publication were prepared are included in this index.


| *Contract No.* | *Abstract No.* | *Report No.* |
|---|---|---|
| **AC01-81CS50058** | **COMSIS Corp., Wheaton, MD (USA)** | |
| | 12:37161 | DOE/CS/50058—T1 |
| **AC01-83NE32117** | **Planning and Human Systems, Inc., Washington, DC (USA)** | |
| | 12:36787 | DOE/NE/32117—H1 |
| **AC02-76CH00016** | **Brookhaven National Lab., Upton, NY (USA)** | |
| | 12:36500 | BNL—52042 |
| | 12:36521 | NUREG/CR—4897 |
| | 12:36557 | BNL—39822 |
| | 12:36779 | BNL—39507 |
| | 12:36780 | BNL—39508 |
| | 12:36781 | BNL—39509 |
| | 12:36784 | BNL—39697 |
| | 12:36811 | BNL-NUREG—39849 |
| | 12:36823 | BNL-NUREG—39134 |
| | 12:36958 | BNL—52052 |
| | 12:37249 | Physical Review Letters 59 NO. 3. 351-354 (20 Jul 1987). |
| | 12:37328 | BNL—39924 |
| | 12:37470 | Physical Review [Section] A: General Physics 36 NO. 3. 1440-1444 (1 Aug 1987). |
| | 12:37540 | BNL—39593 |
| | 12:37600 | BNL—39457 |
| | 12:37709 | BNL—39456 |
| | 12:37767 | BNL—35667 |
| | 12:37873 | BNL—39905 |
| | 12:37874 | BNL—39724 |
| | 12:37937 | BNL—39866 |
| | 12:38049 | BNL—52071 |
| | 12:38112 | BNL—39657 |
| | 12:38113 | BNL—39661 |
| | 12:38114 | BNL—39663 |
| | 12:38115 | BNL—39665 |
| | 12:38155 | BNL—39765 |
| | 12:38215 | BNL—39747 |
| | 12:38237 | BNL—39723 |
| | 12:38295 | BNL—39805 |
| | 12:38320 | BNL—39605 |
| | 12:38407 | BNL—39876 |
| | 12:38418 | BNL—39830 |
| **AC02-76CH03000** | **Fermi National Accelerator Lab., Batavia, IL (USA)** | |
| | 12:37543 | FNAL-TM—1444 |
| | 12:38058 | FNAL/Pub—87/77-A |
| | 12:38125 | FNAL/C—87/71 |
| | 12:38126 | FNAL/C—87/82 |
| | 12:38408 | FNAL-TM—1457 |
| | 12:38409 | FNAL-TM—1458 |
| | 12:38410 | FNAL-TM—1463 |
| **AC02-76CH03073** | **Princeton Univ., NJ (USA). Plasma Physics Lab.** | |
| | 12:38344 | PPPL—2368 |
| | 12:38345 | PPPL—2400 |
| | 12:38346 | PPPL—2402 |
| | 12:38347 | PPPL—2419 |
| | 12:38348 | PPPL—2420 |
| | 12:38349 | PPPL—2422 |
| | 12:38350 | PPPL—2424 |
| | 12:38351 | PPPL—2425 |
| | 12:38352 | PPPL—2427 |
| | 12:38353 | PPPL—2431 |
| | 12:38366 | Journal of Computational Physics 71 NO. 1. 124-146 (Jul 1987). |
| | 12:38382 | PPPL—2421 |
| **AC02-76ER02271** | **Columbia Univ., New York (USA). Dept. of Physics** | |
| | 12:38157 | DOE/ER/02271—110 |
| **AC02-76ER02570** | **Boston Univ., MA (USA). Dept. of Chemistry** | |
| | 12:36624 | DOE/ER/02570—11 |
| **AC02-76ER03130** | **Brown Univ., Providence, RI (USA). Dept. of Physics** | |
| | 12:38118 | DOE/ER/03130—35 |
| | 12:38119 | DOE/ER/03130—262 |
| | 12:38120 | DOE/ER/03130—264 |
| | 12:38158 | DOE/ER/03130—630 |
| | 12:38159 | DOE/ER/03130—T13 |
| **AC02-76ER03416** | **Pennsylvania State Univ., University Park (USA). Dept. of Chemistry** | |
| | 12:37432 | DOE/ER/03416—48 |
| **AC02-76ER04073** | **Arizona Univ., Tucson (USA). Dept. of Chemistry** | |
| | 12:37373 | DOE/ER/04073—20 |
| **AC02-76ER13065** | **Univ. of Rochester, NY** | |
| | 12:38314 | General Relativity and Gravitation 19 NO. 1. 57-71 (Jan 1987). |
| **AC02-78ER04987** | **Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering** | |
| | 12:37392 | DOE/ER/04987—8 |
| **AC02-78ET51013** | **Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center** | |
| | 12:38326 | DOE/ET/51013—206 |
| | 12:38327 | DOE/ET/51013—218 |
| | 12:38328 | DOE/ET/51013—221 |
| **AC02-80ER10699** | **State Univ. of New York, Stony Brook (USA). Research Foundation** | |
| | 12:38122 | DOE/ER/10699—T6 |
| **AC02-80ER10746** | **Sandia National Laboratory, Albuquerque, New Mexico 87185** | |
| | 12:37520 | Journal of Applied Physics 62 NO. 3. 1084-1092 (1 Aug 1987). |
| **AC02-81ER10807** | **Rockefeller Univ., New York (USA)** | |
| | 12:38101 | DOE/ER/10807—03 |
| **AC02-81ER10874** | **Univ. of Illinois, Urbana** | |
| | 12:38009 | Journal of Bacteriology 169 NO. 5. 1886-1890 (May 1987). |
| **AC02-82CE40539** | **Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.** | |
| | 12:37131 | DOE/CE/40539—02 |
| | 12:37132 | DOE/CE/40539—04 |
| | 12:37133 | DOE/CE/40539—05 |
| | 12:37134 | DOE/CE/40539—06 |
| **AC02-82ER12087** | **Illinois Univ., Urbana (USA)** | |
| | 12:36625 | DOE/ER/12087—T4 |
| **AC02-82ER40068** | **Iowa State Univ. of Science and Technology, Ames (USA)** | |
| | 12:38270 | DOE/ER/40068—3 |
| **AC02-82ER40073** | **Chicago Univ., IL (USA)** | |
| | 12:38160 | DOE/ER/40073—T2 |
| **AC02-83CH10093** | **Solar Energy Research Inst., Golden, CO (USA)** | |
| | 12:36601 | SERI/SP—231-2878 |
| | **Poly Solar, Inc., Garland, TX (USA)** | |
| | 12:36634 | SERI/STR—211-3127 |
| | **Cornell Univ., Ithaca, NY (USA)** | |
| | 12:36635 | SERI/STR—211-3148 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | **Solar Energy Research Inst., Golden, CO (USA)** | |
| | 12:36636 | SERI/TR—211-3052 |
| | **Owens-Illinois, Inc., Toledo, OH (USA)** | |
| | 12:36705 | SERI/STR—211-3149 |
| | **Telic Co., Santa Monica, CA (USA)** | |
| | 12:36706 | SERI/STR—255-3040 |
| | 12:37352 | Applied Physics Letters 51 NO. 6. 412-414 (10 Aug 1987). |
| **AC02-83CH10140** | **Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation** | |
| | 12:36496 | BMI/ONWI—636 |
| | 12:36497 | BMI/ONWI—643 |
| | 12:36498 | BMI/ONWI—646 |
| | 12:36499 | BMI/ONWI—647 |
| | **NUS Corp., Gaithersburg, MD (USA)** | |
| | 12:37818 | BMI/ONWI—638 |
| | **Earth Technology Corp., Long Beach, CA (USA)** | |
| | 12:37854 | BMI/ONWI—640 |
| **AC02-83ER40107** | **City Coll., New York (USA)** | |
| | 12:38123 | DOE/ER/40107—T3 |
| **AC02-84ER13163** | **SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics** | |
| | 12:37296 | DOE/ER/13163—14 |
| **AC02-86CE40736** | **BDM Corp., McLean, VA (USA)** | |
| | 12:37135 | DOE/CE/40736—T1 |
| **AC02-86ER40253** | **Stanford Linear Accelerator Center, Menlo Park, CA (USA)** | |
| | 12:38134 | SLAC—312(Jan 1987). |
| **AC02-86NE37959** | **Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering** | |
| | 12:36812 | DOE/NE/37959—2 |
| | 12:36813 | DOE/NE/37959—3 |
| **AC02-87CE90001** | **SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics** | |
| | 12:37295 | DOE/CE/90001—1 |
| **AC03-76SF00012** | **Univ. of California, Los Angeles** | |
| | 12:37880 | Proceedings of the National Academy of Sciences of the United States of America 83 NO. 2. |
| **AC03-76SF00098** | **Lawrence Berkeley Lab., CA (USA)** | |
| | 12:36329 | LBL—23312 |
| | 12:36330 | LBL—23352 |
| | 12:37027 | DOE/BP—63585-1 |
| | **American Council for an Energy-Efficient Economy, Washington, DC** | |
| | 12:37029 | DOE/CE/27460—T25(Aug 1986). |
| | 12:37031 | DOE/CE/27460—T25(Aug 1986). |
| | 12:37040 | DOE/CE/27460—T25(Aug 1986). |
| | 12:37058 | DOE/CE/27460—T25(Aug 1986). |
| | **Lawrence Berkeley Lab., CA (USA)** | |
| | 12:37066 | DOE/SF/00098—T12 |
| | 12:37072 | LBL—20545 |
| | 12:37073 | LBL—20896 |
| | 12:37196 | LBL—23442 |
| | **California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering** | |
| | 12:37224 | LBL—22476 |
| | **Lawrence Berkeley Lab., CA (USA)** | |
| | 12:37225 | LBL—22477 |
| | 12:37226 | LBL—23530 |
| | 12:37227 | LBL—23532 |
| | 12:37228 | LBL—23533 |
| | 12:37339 | LBL—23427 |
| | 12:37340 | LBL—23462 |
| | 12:37401 | LBL—22992 |
| | 12:37402 | LBL—23579 |
| | 12:37421 | Journal of Chemical and Engineering Data 32 NO. 1. 76-80 (Jan 1987). |
| | 12:37506 | LBL—23508 |
| | 12:37513 | LBL—23512 |
| | 12:37514 | LBL—23536 |
| | 12:37558 | Nuclear Instruments and Methods in Physics Research 256 NO. 3. 418-426 (15 May 1987). |
| | 12:37559 | Science (Washington, D.C.) 228 NO. 4705. 1265-1272 (14 Jun 1985). |
| | 12:37560 | LBL—22189 |
| | 12:37561 | LBL—22193 |
| | 12:37564 | LBL—23452 |
| | 12:37712 | LBL—23136 |
| | 12:37829 | Water Resources Research 23 NO. 3. 367-479 (Mar 1987). |
| | 12:38037 | LBL—23477 |
| | 12:38043 | LBL—22718 |
| | 12:38044 | LBL—22747 |
| | 12:38096 | LBL—23307 |
| | 12:38103 | LBL—23342 |
| | 12:38218 | LBL—23122 |
| | 12:38239 | LBL—23570 |
| | 12:38261 | LBL—23381 |
| | 12:38299 | LBL—22991 |
| | 12:38308 | LBL—23578 |
| | 12:38342 | LBL—23299 |
| | 12:38411 | LBL—23259 |
| **AC03-76SF00515** | **Stanford Linear Accelerator Center, CA, USA** | |
| | 12:37545 | Nuclear Instruments and Methods in Physics Research 256 NO. 3. 427-433 (15 May 1987). |
| | **Stanford Linear Accelerator Center, Menlo Park, CA (USA)** | |
| | 12:37554 | SLAC-PUB—4178 |
| | 12:37555 | SLAC-PUB—4209 |
| | 12:37556 | SLAC-PUB—4217 |
| | 12:37557 | SLAC-PUB—4221 |
| | 12:38071 | Nuclear Physics [Section] B 287 NO. 4. 797-814 (15 Jun 1987). |
| | 12:38145 | SLAC-PUB—3928 |
| | 12:38146 | SLAC-PUB—4287 |
| | 12:38147 | SLAC-PUB—4300 |
| | 12:38148 | SLAC-PUB—4312 |
| | 12:38149 | SLAC-PUB—4313 |
| | 12:38196 | SLAC-PUB—4315 |
| | 12:38197 | SLAC-PUB—4323 |
| | 12:38201 | Physical Review [Section] C: Nuclear Physics 36 NO. 2. 691-701 (Aug 1987). |
| | 12:38204 | Physics Letters [Section] B 188 NO. 4. 501-505 (23 Apr 1987). |
| | 12:38223 | SLAC-PUB—4251 |
| | 12:38224 | SLAC-PUB—4316 |
| | 12:38309 | SLAC-PUB—4257 |
| | 12:38310 | SLAC-PUB—4259 |
| **AC03-81SF11564** | **Stanford Univ., CA (USA). Petroleum Research Inst.** | |
| | 12:36382 | DOE/SF/11564—22 |
| | 12:36383 | DOE/SF/11564—23 |
| | 12:36384 | DOE/SF/11564—24 |
| **AC03-84ER53158** | **GA Technologies, Inc., San Diego, CA (USA)** | |
| | 12:38337 | GA-A—18775 |
| **AC03-85SF15774** | **Stroud, Inc., Arvada, CO (USA)** | |
| | 12:37067 | DOE/SF/15774—T2 |
| **AC04-76DP00053** | **Monsanto Research Corp., Miamisburg, OH (USA). Mound** | |
| | 12:36563 | MLM—3441 |
| | 12:37074 | MLM—3436(OP) |
| | 12:37341 | MLM—3428(OP) |
| | 12:37583 | MLM—3442(OP) |
| **AC04-76DP00487** | **Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)** | |
| | 12:36550 | MHSMP—87-18 |
| **AC04-76DP00789** | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:36428 | SAND—87-0706 |
| | 12:36466 | SAND—86-2883C |
| | 12:36467 | SAND—86-2884C |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | 12:36471 | (1986). |
| | 12:36533 | SAND—83-0768 |
| | **Aghabian Associates, El Segundo, CA (USA)** | |
| | 12:36534 | SAND—84-7208 |
| | **RE/SPEC, Inc., Rapid City, SD (USA)** | |
| | 12:36535 | SAND—85-7208 |
| | **Technadyne Engineering Consultants, Inc., Woods Hole, MA (USA)** | |
| | 12:36536 | SAND—86-0929 |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:36537 | SAND—86-0977 |
| | **Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA)** | |
| | 12:36538 | SAND—86-7133 |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:36539 | SAND—87-0115 |
| | 12:36540 | SAND—87-0176 |
| | 12:36564 | SAND—86-2986C |
| | 12:36565 | SAND—87-0180C |
| | 12:36566 | SAND—87-0947C |
| | 12:36567 | SAND—87-0977C |
| | 12:36568 | SAND—87-1022C |
| | 12:36569 | SAND—87-1038C |
| | 12:36570 | SAND—87-1128C |
| | 12:36571 | SAND—87-1224C |
| | 12:36579 | SAND—86-0173 |
| | 12:36593 | SAND—87-0682C |
| | 12:36600 | SAND—87-0683C |
| | 12:36648 | SAND—87-0804C |
| | 12:36656 | SAND—86-2165 |
| | 12:36657 | SAND—86-2823C |
| | **Stirling Thermal Motors, Inc., Ann Arbor, MI (USA)** | |
| | 12:36658 | SAND—86-2828C |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:36687 | SAND—85-2317-Rev. |
| | 12:36726 | SAND—87-0922C |
| | 12:36742 | SAND—87-0501 |
| | 12:36789 | SAND—87-0638C |
| | 12:36800 | SAND—86-1457C |
| | 12:36806 | SAND—87-1091C |
| | **Brookhaven National Lab., Upton, NY (USA)** | |
| | 12:36880 | NUREG/CP—0082-Vol.5(Feb 1987). |
| | **Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research** | |
| | 12:36901 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36910 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36912 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36913 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36915 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36916 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:36918 | NUREG/CR—4098 |
| | 12:36923 | NUREG/CR—4679 |
| | 12:36924 | NUREG/CR—4681 |
| | 12:36925 | NUREG/CR—4772 |
| | 12:36927 | NUREG/CR—4830 |
| | 12:36929 | SAND—86-2869C |
| | 12:36930 | SAND—87-0184 |
| | 12:36944 | SAND—86-1266 |
| | 12:36945 | SAND—87-0393 |
| | **Johnson Controls, Inc., Milwaukee, WI (USA)** | |
| | 12:36946 | SAND—87-7115C |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:37008 | SAND—87-1306C |
| | **Syracuse Univ., NY (USA). Lab. of Solid State Science and Technology** | |
| | 12:37238 | SAND—85-2568 |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:37239 | SAND—86-2670C |
| | 12:37240 | SAND—87-0071C |
| | 12:37241 | SAND—87-0622C |
| | 12:37242 | SAND—87-0741C |
| | 12:37258 | Corrosion (Houston) 43 NO. 1. 2-7 (Jan 1987). |
| | 12:37304 | SAND—86-2750C |
| | 12:37305 | Journal of Materials Research 2 NO. 4. 421-423 (Jul 1987). |
| | 12:37347 | SAND—87-0178 |
| | 12:37348 | SAND—87-0315 |
| | 12:37349 | SAND—87-0404C |
| | 12:37350 | SAND—87-0620 |
| | 12:37351 | SAND—87-0636C |
| | 12:37354 | Physical Review Letters 59 NO. 3. 347-350 (20 Jul 1987). |
| | 12:37380 | SAND—87-0146C |
| | 12:37407 | SAND—87-1402C |
| | 12:37408 | SAND—87-1654C |
| | 12:37430 | (1985). |
| | 12:37460 | SAND—86-2447C |
| | 12:37461 | SAND—86-2470 |
| | 12:37462 | SAND—87-0094C |
| | 12:37463 | SAND—87-0273C |
| | 12:37464 | SAND—87-0641C |
| | 12:37465 | SAND—87-1702C |
| | 12:37508 | SAND—86-2774C |
| | 12:37515 | SAND—86-0587 |
| | 12:37516 | SAND—87-0403C |
| | 12:37517 | SAND—87-1632C |
| | 12:37519 | Journal of Applied Physics 62 NO. 3. 1074-1083 (1 Aug 1987). |
| | 12:37578 | SAND—86-0236 |
| | 12:37579 | SAND—86-1606C |
| | 12:37596 | SAND—87-0283C |
| | **Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA)** | |
| | 12:37822 | SAND—85-0008 |
| | **RE/SPEC, Inc., Albuquerque, NM (USA)** | |
| | 12:38046 | SAND—85-7100 |
| | **Sandia National Labs., Albuquerque, NM (USA)** | |
| | 12:38047 | SAND—87-1227 |
| | 12:38300 | SAND—86-2874 |
| | 12:38301 | SAND—87-0765C |
| | 12:38398 | SAND—87-0002C |
| | 12:38399 | SAND—87-0800C |
| | **Texas Univ., Austin (USA)** | |
| | 12:38412 | SAND—87-1114C |
| **AC04-76DP03533** | **Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant** | |
| | 12:36484 | RFP—4105 |
| | 12:36490 | RFP—4106 |
| | 12:36491 | RFP—4128 |
| | 12:36807 | RFP-Trans—465(Apr 1987). |
| | 12:37232 | RFP—3987 |
| | 12:37233 | RFP—4046 |
| | 12:37379 | RFP—4119 |
| | 12:37723 | RFP-ENV—86 |
| | 12:37933 | RFP—4124 |
| **AC04-76DR00789** | **Sandia National Labs., Livermore, CA (USA)** | |
| | 12:36659 | SAND—87-8008 |
| **AC05-78ET53043** | **GA Technologies, Inc., San Diego, CA (USA)** | |
| | 12:38380 | GA-A—18842 |
| **AC05-84ER40150** | **Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)** | |
| | 12:37529 | DOE/ER/40150—1 |
| | 12:37530 | DOE/ER/40150—8 |
| | 12:37531 | DOE/ER/40150—24 |
| | 12:37532 | DOE/ER/40150—29 |
| | 12:37541 | DOE/ER/40150—7 |
| | 12:37542 | DOE/ER/40150—27 |
| | 12:37548 | DOE/ER/40150—10 |
| | 12:37549 | DOE/ER/40150—13 |
| | 12:38124 | DOE/ER/40150—25 |
| | **Maryland Univ., College Park (USA)** | |
| | 12:38161 | DOE/ER/40150—12 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | **Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)** | |
| | 12:38230 | DOE/ER/40150—15 |
| | 12:38234 | DOE/ER/40150—2 |
| | 12:38235 | DOE/ER/40150—9 |
| | 12:38271 | DOE/ER/40150—22 |
| | 12:38272 | DOE/ER/40150—23 |
| AC05-84OR21400 | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36240 | CONF-870659—2 |
| | **USDOE Morgantown Energy Technology Center, WV** | |
| | 12:36250 | DOE/METC—86/6069(Jan 1987). |
| | 12:36251 | DOE/METC—86/6069(Jan 1987). |
| | 12:36289 | (1985). |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36295 | CONF-870764—1 |
| | 12:36296 | CONF-870802—5 |
| | 12:36297 | CONF-870802—9 |
| | 12:36362 | ORNL/TM—9821 |
| | 12:36482 | International Journal for Numerical Methods in Fluids 7 NO. 3. 215-231 (Mar 1987). |
| | 12:36483 | International Journal for Numerical Methods in Fluids 7 NO. 3. 233-246 (Mar 1987). |
| | 12:36488 | ORNL/TM—10359 |
| | 12:36502 | CONF-870801—1 |
| | **Lawrence Berkeley Lab., CA (USA)** | |
| | 12:36522 | ORNL/Sub—85-21674/1 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36523 | ORNL/TM—9681 |
| | 12:36524 | ORNL/TM—10289 |
| | 12:36525 | ORNL/TM—10338 |
| | 12:36526 | ORNL/TM—10474 |
| | 12:36632 | ORNL—6369 |
| | 12:36750 | ORNL—6380 |
| | 12:36755 | ORNL/TM—10206/P1 |
| | **Electric Research and Management, St. Rose, LA (USA)** | |
| | 12:36767 | CONF-870757—1 |
| | **AEP Service Corp., Columbus, OH (USA)** | |
| | 12:36768 | CONF-870757—2 |
| | **Virginia Polytechnic Inst., Blacksburg (USA)** | |
| | 12:36769 | CONF-870877—1 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36773 | NUREG/CR—4860 |
| | **Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center** | |
| | 12:36777 | CONF-870501—3 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36786 | CONF-870804—5 |
| | 12:36795 | NUREG/CR—2000-Vol.6-No.1 |
| | 12:36796 | NUREG/CR—2000-Vol.6-No.2 |
| | 12:36797 | NUREG/CR—2000-Vol.6-No.4 |
| | 12:36802 | CONF-870501—4 |
| | **Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research** | |
| | 12:36900 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36921 | NUREG/CR—4674-Vol.3 |
| | 12:36922 | NUREG/CR—4674-Vol.4 |
| | 12:36948 | Journal of Chemical and Engineering Data 32 NO. 1. 41-44 (Jan 1987). |
| | 12:36959 | DOE/HWP—25 |
| | **Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)** | |
| | 12:36960 | ES/ESH—2 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:36962 | ORNL—6405 |
| | **Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)** | |
| | 12:36963 | ORNL/ESH—1/V23 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37023 | CONF-870174—1 |
| | 12:37025 | CONF-870804—10 |
| | 12:37026 | CONF-870811—2 |
| | 12:37077 | ORNL/CON—196 |
| | 12:37078 | ORNL/CON—229 |
| | 12:37129 | CONF-8706124—1 |
| | 12:37160 | CONF-870210—1 |
| | 12:37207 | CONF-870178—1 |
| | 12:37210 | CONF-870862—3 |
| | 12:37211 | CONF-870862—5 |
| | 12:37212 | CONF-870873—2 |
| | **Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering** | |
| | 12:37231 | ORNL/Sub—85-27488/01 |
| | **North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering** | |
| | 12:37281 | CONF-851217—70 |
| | **Advanced Refractory Technologies, Inc., Buffalo, NY (USA)** | |
| | 12:37282 | CONF-860883—2 |
| | **Oak Ridge Associated Universities, Inc., TN (USA)** | |
| | 12:37289 | CONF-870862—1 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37290 | CONF-870862—6 |
| | 12:37291 | CONF-870873—3 |
| | 12:37294 | CONF-8706125—3-Draft |
| | 12:37301 | ORNL/TM—10403 |
| | 12:37331 | CONF-8706151—1-Draft |
| | 12:37332 | CONF-8706152—1 |
| | 12:37371 | CONF-870763—1 |
| | 12:37372 | CONF-870763—2 |
| | 12:37377 | ORNL/TM—10309 |
| | 12:37378 | ORNL/TM—10402 |
| | 12:37382 | Analytical Chemistry 59 NO. 13. 1644-1646 (1 Jul 1987). |
| | 12:37383 | Analytical Chemistry 59 NO. 13. 1670-1674 (1 Jul 1987). |
| | 12:37386 | Applied Spectroscopy 41 NO. 4. 605-609 (May 1987). |
| | 12:37388 | CONF-870759—1 |
| | 12:37453 | CONF-870601—9 |
| | **Lawrence Livermore National Lab., CA (USA)** | |
| | 12:37474 | CONF-870401—3-Abst. |
| | **Cornell Univ., Ithaca, NY (USA)** | |
| | 12:37511 | CONF-8705108—1 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37512 | CONF-8705117—1 |
| | 12:37524 | Review of Scientific Instruments 58 NO. 8. 1533-1533 (Aug 1987). |
| | 12:37544 | Nuclear Instruments and Methods in Physics Research 256 NO. 3. 409-417 (15 May 1987). |
| | 12:37547 | CONF-870498—3 |
| | 12:37568 | ORNL/TM—10421 |
| | **National Bureau of Standards, Washington, DC (USA)** | |
| | 12:37577 | CONF-8704112—6 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37605 | CONF-8704155—1 |
| | **Columbia Univ., Palisades, NY (USA). Tree-Ring Lab.** | |
| | 12:37738 | CONF-8608141—(Apr 1987). |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37819 | CONF-8705132—1 |
| | 12:37833 | CONF-8703144—1 |
| | 12:37838 | CONF-8703141—1-Summ. |
| | 12:37859 | ORNL—6397 |
| | 12:37860 | CONF-870523—3 |
| | **Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry** | |
| | 12:37861 | CONF-8704151—1 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:37878 | ORNL/TM—10377 |
| | 12:37901 | CONF-8705116—2 |
| | 12:37902 | CONF-8705116—3 |
| | 12:37936 | CONF-8704145—1 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | **Columbia Univ., Palisades, NY (USA). Tree-Ring Lab.** | |
| | 12:37949 | CONF-8608141—(Apr 1987). |
| | 12:37952 | CONF-8608141—(Apr 1987). |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:38039 | ORNL/TM—10112 |
| | 12:38094 | CONF-870752—1-Ext.Abst. |
| | 12:38251 | CONF-8706113—2 |
| | 12:38253 | Physical Review [Section] C: Nuclear Physics 36 NO. 2. 826-829 (Aug 1987). |
| | 12:38266 | CONF-8706142—1 |
| | 12:38274 | ORNL/TM—10219 |
| | 12:38278 | Nuclear Science and Engineering 95 NO. 4. 304-310 (Apr 1987). |
| | 12:38291 | CONF-870405—10 |
| | 12:38321 | CONF-870570—9 |
| | 12:38323 | CONF-8706119—1 |
| | **KMS Fusion, Inc., Ann Arbor, MI (USA)** | |
| | 12:38339 | KMSF-U—1566 |
| | **Oak Ridge National Lab., TN (USA)** | |
| | 12:38368 | CONF-870292—1-Vugraphs |
| | 12:38369 | CONF-870405—4-Vugraphs |
| | 12:38371 | CONF-870570—12 |
| | 12:38372 | CONF-870629—1 |
| | 12:38373 | CONF-870629—2 |
| | 12:38374 | CONF-870629—3 |
| | 12:38375 | CONF-8703140—1-Vugraphs |
| | 12:38376 | CONF-8705133—1-Vugraphs |
| AC05-84OS21400 | **Oak Ridge Y-12 Plant, TN (USA)** | |
| | 12:36573 | Y/DS—254 |
| AC05-84OT21400 | **Science Applications, Inc., Oak Ridge, TN (USA)** | |
| | 12:36479 | K/TS—11-869 |
| | **Geraghty and Miller, Inc., Oak Ridge, TN (USA)** | |
| | 12:36517 | K/SUB—85-22224/3 |
| | 12:36518 | K/SUB—85-22224/5 |
| AC06-76FF02170 | **Hanford Engineering Development Lab., Richland, WA (USA)** | |
| | 12:36516 | HEDL-TME—85-22 |
| | 12:36783 | HEDL-SA—3491 |
| | 12:36788 | HEDL-SA—3188 |
| | 12:36815 | HEDL-SA—3359 |
| | 12:36820 | HEDL-SA—3349 |
| | 12:36831 | HEDL-SA—3629 |
| | 12:37220 | HEDL-SA—3418 |
| | 12:37505 | HEDL-SA—3673-FP |
| | 12:38245 | HEDL-SA—3530 |
| AC06-76RL01830 | **USDOE Morgantown Energy Technology Center, WV** | |
| | 12:36301 | DOE/METC—86/6069(Jan 1987). |
| | **Pacific Northwest Lab., Richland, WA (USA)** | |
| | 12:36478 | PNL-SA—14499 |
| | 12:36489 | PNL—6261 |
| | 12:36493 | PNL—6162 |
| | 12:36494 | PNL—6189 |
| | 12:36527 | PNL—6148 |
| | 12:36528 | PNL-SA—14426 |
| | **Kent State Univ., OH (USA)** | |
| | 12:36529 | PNL-SA—14624 |
| | **Pacific Northwest Lab., Richland, WA (USA)** | |
| | 12:36530 | PNL-SA—14767 |
| | **Pacific Northwest Lab., Richland, WA (USA). Salt Repository Project** | |
| | 12:36531 | PNL/SRP—6253 |
| | **Pacific Northwest Lab., Richland, WA (USA)** | |
| | 12:36555 | PNL-SA—14225 |
| | 12:36591 | PNL-SA—14315 |
| | 12:36592 | PNL-SA—14377 |
| | 12:36655 | PNL-SA—14022 |
| | 12:36736 | Journal of Applied Meteorology 26 NO. 6. 675-686 (Jun 1987). |
| | 12:36778 | NUREG/CR—3231 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | **UNC Nuclear Industries, Inc., Richland, WA (USA)** | |
| | 12:36810 | UNI-SA—166 |
| | **Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research** | |
| | 12:36904 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | **Pacific Northwest Lab., Richland, WA (USA)** | |
| | 12:36939 | PNL—6251 |
| | 12:37014 | PNL-SA—14605 |
| | 12:37080 | PNL—5881 |
| | 12:37081 | PNL—6176 |
| | 12:37103 | PNL—5953 |
| | 12:37148 | PNL—6208 |
| | 12:37302 | PNL-SA—14497 |
| | 12:37303 | PNL-SA—14744 |
| | 12:37406 | PNL-SA—14400 |
| | 12:37569 | PNL-SA—14244 |
| | 12:37704 | PNL-SA—14768 |
| | 12:37722 | PNL—6036 |
| | 12:37816 | PNL—5751 |
| | 12:37931 | NUREG/CR—4653 |
| | 12:37932 | PNL-SA—14190 |
| | 12:38006 | PNL—5979 |
| | 12:38016 | PNL-SA—14976 |
| | 12:38045 | PNL-SA—14276 |
| AC06-76RL01857 | **UNC Nuclear Industries, Inc., Richland, WA (USA)** | |
| | 12:36816 | UNI—3760 |
| | 12:36817 | UNI—4065 |
| AC06-77RL01030 | **Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations** | |
| | 12:36532 | RHO-RE-SA—182 |
| | **Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations** | |
| | 12:36829 | GEND—061 |
| AC06-81ER40048 | **Washington Univ., Seattle (USA). Nuclear Physics Lab.** | |
| | 12:38244 | DOE/ER/40048—192 |
| | **Washington Univ., Seattle (USA). Dept. of Physics** | |
| | 12:38268 | DOE/ER/40048—19-N7 |
| | 12:38269 | DOE/ER/40048—20-N7 |
| AC07-76ID01570 | **EG and G Idaho, Inc., Idaho Falls (USA)** | |
| | 12:36515 | EGG-M—29786 |
| | **Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research** | |
| | 12:36841 | NUREG/CP—0082-Vol.4(Feb 1987). |
| | 12:36847 | NUREG/CP—0082-Vol.4(Feb 1987). |
| | 12:36866 | NUREG/CP—0082-Vol.5(Feb 1987). |
| | 12:36868 | NUREG/CP—0082-Vol.5(Feb 1987). |
| | 12:36894 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36895 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36896 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | 12:36908 | NUREG/CP—0082-Vol.6(Feb 1987). |
| | **EG and G Idaho, Inc., Idaho Falls (USA)** | |
| | 12:36919 | NUREG/CR—4165 |
| | 12:36920 | NUREG/CR—4617 |
| | 12:36975 | EGG-M—00387 |
| | **PAR Enterprises, Inc., Fairfax, VA (USA)** | |
| | 12:37136 | DOE/ID—10150 |
| | **EG and G Idaho, Inc., Idaho Falls (USA)** | |
| | 12:37137 | DOE/ID—10171 |
| | 12:37570 | Nuclear Instruments and Methods in Physics Research 256 NO. 2. 355-360 (1 May 1987). |
| | 12:38378 | EGG—2508 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| AC07-81NE44139 | West Valley Nuclear Services Co., Inc., West Valley, NY (USA) | |
| | 12:36507 | DOE/NE/44139—27 |
| | 12:36508 | DOE/NE/44139—33 |
| | 12:36553 | DOE/NE/44139—20 |
| AC07-85ID12560 | Manville Service Corp., Denver, CO (USA) | |
| | 12:37139 | DOE/ID/12560—4 |
| AC07-85ID12583 | TENSA Services, Houston, TX (USA) | |
| | 12:37140 | DOE/ID/12583—2 |
| AC07-86ID12584 | UNC Geotech, Grand Junction, CO (USA) | |
| | 12:37820 | DOE/ID/12584—5 |
| AC08-84NV10322 | Fenix and Scisson, Inc., Las Vegas, NV (USA) | |
| | 12:37455 | CONF-8705113—1 |
| AC09-76SR00001 | Savannah River Lab., Aiken, SC (USA) | |
| | 12:36485 | DP-MS—86-164 |
| | 12:36486 | DP-MS—87-9 |
| | 12:36487 | DP-MS—87-55 |
| | 12:36510 | DP-MS—86-138 |
| | Bechtel National, Inc., San Francisco, CA (USA) | |
| | 12:36511 | DP-MS—87-1 |
| | 12:36512 | DP-MS—87-10 |
| | Savannah River Lab., Aiken, SC (USA) | |
| | 12:36513 | DP-MS—87-51 |
| | 12:36514 | DPST—85-953 |
| | 12:36549 | DPST—85-856 |
| | 12:36556 | SI—85-4-23-Del.Ver. |
| | Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant | |
| | 12:36559 | DP-MS—86-8 |
| | Savannah River Lab., Aiken, SC (USA) | |
| | 12:36825 | DP-MS—87-49 |
| | 12:37218 | DP-MS—86-151 |
| | Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant | |
| | 12:37457 | DP-MS—87-62 |
| | Savannah River Lab., Aiken, SC (USA) | |
| | 12:37808 | DP-MS—86-149 |
| | 12:37821 | DP-MS—87-37 |
| | 12:37825 | DP-MS—86-155 |
| | 12:37826 | DPST—85-704 |
| AC19-85BC10841 | Texas Univ., Austin (USA). Dept. of Petroleum Engineering | |
| | 12:36378 | DOE/BC/10841—5 |
| AC19-85BC10846 | Texas Univ., Austin (USA). Dept. of Petroleum Engineering | |
| | 12:36379 | DOE/BC/10846—5 |
| AC19-85BC10847 | Illinois Inst. of Tech., Chicago (USA) | |
| | 12:36380 | DOE/BC/10847—5 |
| AC21-82MC19210 | General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center | |
| | 12:36299 | DOE/MC/19210—2357 |
| AC21-82MC19403 | Institute of Gas Technology, Chicago, IL (USA) | |
| | 12:37011 | DOE/MC/19403—1816 |
| AC21-84MC21097 | Parsons (Ralph M.) Co., Pasadena, CA (USA) | |
| | 12:36241 | DOE/MC/21097—2338 |
| AC21-84MC21131 | Global Geochemistry Corp., Canoga Park, CA (USA) | |
| | 12:36430 | DOE/MC/21131—2350 |
| AC21-84MC21349 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36347 | DOE/METC—86/6069(Jan 1987). |
| AC21-85PC10627 | Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences | |
| | 12:36353 | DOE/FC/10627—2363 |
| AC21-85MC22109 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36246 | DOE/METC—86/6069(Jan 1987). |
| AC21-85MC22249 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36248 | DOE/METC—86/6069(Jan 1987). |
| AC21-86MC22068 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:37456 | DOE/METC—86/6069(Jan 1987). |
| AC21-86MC22250 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36247 | DOE/METC—86/6069(Jan 1987). |
| AC21-86MC23249 | West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering | |
| | 12:36354 | DOE/MC/23249—2360 |
| AC22-82PC50041 | Southern Co. Services, Inc., Birmingham, AL (USA) | |
| | 12:36273 | EPRI-AP—5221 |
| AC22-83PC60015 | Wyoming Univ., Laramie (USA). Office of Univ. Research | |
| | 12:36310 | DOE/PC/60015—44 |
| AC22-83PC62700 | Holt Associates, Inc., Fairfax, VA (USA) | |
| | 12:36364 | DOE/PC/62700—T10 |
| AC22-85PC80011 | Air Products and Chemicals, Inc., Allentown, PA (USA) | |
| | 12:36582 | DOE/PC/80011—T1 |
| AC22-85PC80016 | SRI International, Menlo Park, CA (USA) | |
| | 12:36583 | DOE/PC/80016—T3 |
| | 12:36584 | DOE/PC/80016—T4 |
| AC22-85PC81210 | Michigan Technological Univ., Houghton (USA). Inst. of Materials Processing | |
| | 12:36236 | DOE/PC/81210—T15 |
| AC22-86PC90275 | Combustion Engineering, Inc., Windsor, CT (USA) | |
| | 12:36361 | DOE/PC/90275—T4 |
| AC79-84BP18945 | United Industries Corp., Bellevue, WA (USA) | |
| | 12:37130 | DOE/BP/18945—T7 |
| AI03-82SF11653 | National Bureau of Standards, Washington, DC (USA). Thermophysics Div. | |
| | 12:36725 | DOE/SF/11653—T12 |
| AI05-83ER13108 | National Bureau of Standards, Washington, DC (USA). Chemical Kinetics Div. | |
| | 12:37434 | DOE/ER/13108—T4 |
| AI09-76SR00870 | Forest Service, Asheville, NC (USA). Southeastern Forest Experiment Station | |
| | 12:37765 | DOE/SR/00870—40 |
| AI21-80ET17088 | National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center | |
| | 12:37012 | DOE/NASA/17088—5 |
| AI21-81MC16512 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36245 | DOE/METC—86/6069(Jan 1987). |
| AI21-84MC21032 | USDOE Morgantown Energy Technology Center, WV | |
| | 12:36254 | DOE/METC—86/6069(Jan 1987). |
| | 12:36256 | DOE/METC—86/6069(Jan 1987). |
| AS03-76ER70102 | Univ. of California, Los Angeles | |
| | 12:37866 | Biochemistry 26 NO. 6. 1512-1517 (24 Mar 1987). |
| AS03-78ER70278 | California Univ., Los Angeles (USA). Dept. of Chemistry and Biochemistry | |
| | 12:36640 | UCLA—34P278-61 |
| AS04-76ER03591 | New Mexico State Univ., Las Cruces (USA) | |
| | 12:38238 | DOE/ER/03591—1 |
| AS05-76ER05096 | Rice Univ., Houston, TX (USA). Bonner Nuclear Labs. | |
| | 12:38121 | DOE/ER/05096—26 |
| AS05-76ER05126 | Maryland Univ., College Park (USA). Dept. of Physics and Astronomy | |
| | 12:38267 | DOE/ER/05126—307 |
| AS05-78ER06042 | Texas A and M Univ., College Station (USA). Dept. of Chemistry | |
| | 12:37333 | DOE/ER/06042—7 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| **AS05-78EV05854** | **Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics** | |
| | 12:37863 | DOE/EV/05854—9 |
| **AS05-80ER10604** | **Texas Tech Univ., Lubbock (USA)** | |
| | 12:37374 | DOE/ER/10604—7 |
| **AS05-80ER10638** | **Texas Univ., Austin (USA). Dept. of Physics** | |
| | 12:38229 | DOE/ER/10638—7 |
| **AS05-84ER13159** | **Texas Tech Univ., Lubbock** | |
| | 12:37358 | Analytical Chemistry 59 NO. 11. 1583-1584 (1 Jun 1987). |
| **AT03-80ET33075** | **California Univ., Berkeley (USA). Dept. of Chemistry** | |
| | 12:37395 | DOE/ET/33075—T1 |
| **FC01-84CE24444** | **Alliance to Save Energy, Washington, DC (USA)** | |
| | 12:37028 | DOE/CE/24444—T1 |
| **FC03-82CE30701** | **Sacramento Municipal Utility District, CA (USA)** | |
| | 12:36649 | SMUD-PV—2 |
| **FC07-79RA23209** | **Antrim, County of, Bellaire, MI (USA)** | |
| | 12:36615 | DOE/RA/23209—1 |
| **FC07-81ID12170** | **AiResearch Mfg. Co., Torrance, CA (USA)** | |
| | 12:37138 | DOE/ID/12170—2 |
| **FC21-83FE60177** | **Western Research Inst., Laramie, WY (USA)** | |
| | 12:36468 | DOE/FE/60177—2365 |
| | 12:36469 | DOE/FE/60177—2375 |
| | 12:36473 | DOE/FE/60177—2366 |
| | 12:36474 | DOE/FE/60177—2367 |
| | 12:36475 | DOE/FE/60177—2368 |
| **FC22-83FE60339** | **Southern Illinois Univ., Carbondale** | |
| | 12:37870 | Journal of Bacteriology 169 NO. 3. 1267-1271 (Mar 1987). |
| **FC22-86PC91272** | **Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center** | |
| | 12:36239 | DOE/PC/91272—T11 |
| **FG01-85CE24422** | **American Council for an Energy-Efficient Economy, Washington, DC** | |
| | 12:37035 | DOE/CE/27460—T25(Aug 1986). |
| **FG01-85CE26526** | **Lincoln, City of, NE (USA)** | |
| | 12:37155 | DOE/CE/26526—T1 |
| **FG01-86CE63492** | **Maine Development Foundation, Augusta (USA)** | |
| | 12:38391 | DOE/CE/63492—T3 |
| **FG01-86CE63498** | **Community Action Commission of Fayette County, Washington Court House, OH (USA)** | |
| | 12:38392 | DOE/CE/63498—T1 |
| **FG01-86CE63503** | **Center for Neighborhood Technology, Chicago, IL (USA)** | |
| | 12:37061 | DOE/CE/63503—T1 |
| | 12:37062 | DOE/CE/63503—T2 |
| | 12:37063 | DOE/CE/63503—T3-Pt.1 |
| | **Illinois Univ., Chicago (USA). Energy Resources Center** | |
| | 12:37064 | DOE/CE/63503—T3-Pt.2 |
| | 12:37065 | DOE/CE/63503—T3-Pt.3 |
| **FG02-84ER13197** | **New York State Dept. of Health, Albany** | |
| | 12:37882 | Journal of Bacteriology 169 NO. 2. 666-669 (Feb 1987). |
| **FG02-84ER13241** | **Univ. of Illinois, Urbana** | |
| | 12:37872 | Journal of Bacteriology 169 NO. 2. 660-665 (Feb 1987). |
| **FG02-84ER13295** | **Pennsylvania State Univ., University Park (USA). Dept. of Chemistry** | |
| | 12:37393 | DOE/ER/13295—T1 |
| **FG02-84ER40158** | **Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences** | |
| | 12:38162 | DOE/ER/40158—3 |
| **FG02-84ER45077** | **Pennsylvania State Univ., University Park (USA). Materials Research Lab.** | |
| | 12:37334 | DOE/ER/45077—3 |
| **FG02-84ER45160** | **Missouri Univ., Columbia (USA). Research Reactor Facility** | |
| | 12:38292 | DOE/ER/45160—1 |
| **FG02-85CH10235** | **Howard Univ., Washington, DC (USA). Dept. of Chemistry** | |
| | 12:37391 | DOE/CH/10235—2 |
| **FG02-85ER13327** | **Indiana Univ.-Purdue Univ., Indianapolis (USA)** | |
| | 12:37394 | DOE/ER/13327—2 |
| **FG02-85ER13376** | **Univ. of Wisconsin, Madison** | |
| | 12:36604 | Journal of Bacteriology 169 NO. 5. 2150-2157 (May 1987). |
| | 12:38008 | Journal of Bacteriology 169 NO. 5. 2063-2068 (May 1987). |
| **FG02-85ER13433** | **Univ. of Minnesota, Minneapolis** | |
| | 12:37445 | Plasma Chemistry and Plasma Processing 7 NO. 2. 211-229 (Jun 1987). |
| **FG02-85ER13449** | **Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy** | |
| | 12:38324 | DOE/ER/13449—T8 |
| **FG02-85ER52118** | **Rensselaer Polytechnic Inst., Troy, NY (USA)** | |
| | 12:38377 | DOE/ER/52118—2 |
| **FG02-85ER60381** | **Michigan Univ., Ann Arbor (USA). Biological Station** | |
| | 12:36627 | DOE/ER/60381—2 |
| **FG02-85ER75173** | **Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.** | |
| | 12:36819 | DOE/ER/75173—1 |
| **FG02-86ER13546** | **Chicago Univ., IL (USA)** | |
| | 12:37862 | DOE/ER/13546—1 |
| **FG02-86ER25014** | **Society for Industrial and Applied Mathematics, Philadelphia, PA (USA)** | |
| | 12:38102 | DOE/ER/25014—1 |
| **FG02-86ER40278** | **Wisconsin Univ., Madison (USA)** | |
| | 12:38207 | (1987). |
| **FG02-86ER52127** | **Illinois Univ., Urbana (USA). Fusion Studies Lab.** | |
| | 12:38325 | DOE/ER/52127—12 |
| **FG02-86ER60405** | **Armed Forces Radiobiology Research Institute, Bethesda, MD** | |
| | 12:38010 | Biochemistry 26 NO. 5. 1351-1358 (10 Mar 1987). |
| **FG03-84SF15303** | **Wisconsin Univ., Madison (USA). Solar Energy Lab.** | |
| | 12:36681 | DOE/SF/15303—1 |
| | 12:36682 | DOE/SF/15303—2 |
| **FG03-85SF15799** | **Hawaii Univ., Hilo (USA)** | |
| | 12:36731 | DOE/SF/15799—T12 |
| **FG03-86ER52130** | **California Univ., Los Angeles (USA). Tokamak Fusion Lab.** | |
| | 12:38355 | UCLA/PPG—1070 |
| **FG05-80ET53088** | **Texas Univ., Austin (USA). Inst. for Fusion Studies** | |
| | 12:38329 | DOE/ET/53088—213 |
| | 12:38330 | DOE/ET/53088—254 |
| | 12:38331 | DOE/ET/53088—275 |
| | 12:38332 | DOE/ET/53088—276 |
| | 12:38333 | DOE/ET/53088—277 |
| | 12:38334 | DOE/ET/53088—279 |
| **FG05-84ER45135** | **Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy** | |
| | 12:38297 | DOE/ER/45135—17 |
| **FG05-84OR21495** | **Howard Univ., Washington, DC (USA). Dept. of Mechanical Engineering** | |
| | 12:36492 | DOE/OR/21495—T1 |
| **FG05-86ER13465** | **Alabama Univ., University (USA). Dept. of Chemistry** | |
| | 12:37435 | DOE/ER/13465—2 |
| **FG05-86ER40272** | **Florida Univ., Gainesville (USA). Dept. of Physics** | |
| | 12:38057 | DOE/ER/40272—32 |
| | 12:38216 | DOE/ER/40272—37 |
| | 12:38217 | DOE/ER/40272—38 |
| | **Stanford Linear Accelerator Center, Menlo Park, CA (USA)** | |
| | 12:38220 | SLAC—312(Jan 1987). |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| **FG05-86ER45280** | **Florida Univ., Gainesville (USA). Dept. of Physics** | |
| | 12:37217 | DOE/ER/45280—1 |
| **FG06-84ER45163** | **Washington Univ., Seattle (USA). Dept. of Physics** | |
| | 12:37335 | DOE/ER/45163—10 |
| **FG06-86ER13532** | **Washington Univ., Seattle (USA)** | |
| | 12:36626 | DOE/ER/13532—1 |
| | 12:37865 | Journal of Bacteriology 169 NO. 5. 2086-2091 (May 1987). |
| **FG07-84ID12524** | **Alaska Dept. of Natural Resources, Fairbanks (USA). Div. of Geological and Geophysical Surveys** | |
| | 12:36721 | DOE/ID/12524—T2 |
| **FG21-85LC11067** | **Cliffs Engineering, Inc., Rifle, CO (USA)** | |
| | 12:36477 | DOE/LC/11067—2235-Vol.2 |
| **FG22-83PC60038** | **Brigham Young Univ., Provo, UT (USA)** | |
| | 12:36260 | DOE/PC/60038—T6 |
| **FG22-84PC70753** | **Texas Southern Univ., Houston (USA). Dept. of Chemistry** | |
| | 12:36265 | DOE/PC/70753—T11 |
| **FG22-84PC70765** | **Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemical Engineering** | |
| | 12:36360 | DOE/PC/70765—9 |
| **FG22-84PC70777** | **Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering** | |
| | 12:37396 | DOE/PC/70777—T2 |
| **FG22-84PC70780** | **Delaware Univ., Newark (USA). Center for Catalytic Science and Technology** | |
| | 12:36597 | DOE/PC/70780—T7 |
| **FG22-84PC70786** | **State Univ. of New York, Binghamton (USA)** | |
| | 12:36266 | DOE/PC/70786—T9 |
| **FG22-84PC70809** | **University of Southern California, Los Angeles (USA)** | |
| | 12:36311 | DOE/PC/70809—T14 |
| **FG22-84PC70812** | **Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering** | |
| | 12:36267 | DOE/PC/70812—11 |
| **FG22-84PC73226** | **Georgia Inst. of Tech., Atlanta (USA). Dept. of Chemical Engineering** | |
| | 12:37606 | DOE/PC/73226—4 |
| **FG22-85PC80518** | **Montana State Univ., Bozeman (USA)** | |
| | 12:36268 | DOE/PC/80518—T7 |
| **FG22-85PC80525** | **Pittsburgh Univ., PA (USA). School of Engineering** | |
| | 12:36269 | DOE/PC/80525—T7 |
| **FG22-85PC80537** | **Howard Univ., Washington, DC (USA). School of Engineering** | |
| | 12:36312 | DOE/PC/80537—T4 |
| | 12:36313 | DOE/PC/80537—T5 |
| | 12:36314 | DOE/PC/80537—T6 |
| **FG22-85PC80908** | **Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry** | |
| | 12:36270 | DOE/PC/80908—4 |
| **FG22-85PC80913** | **Mississippi Univ., University (USA). Dept. of Biology** | |
| | 12:36315 | DOE/PC/80913—7 |
| **FG22-86PC90502** | **Alabama Univ., University (USA). Dept. of Chemistry** | |
| | 12:36316 | DOE/PC/90502—3 |
| **FG22-86PC90504** | **Auburn Univ., AL (USA). Coal Conversion Lab.** | |
| | 12:36317 | DOE/PC/90504—T3 |
| **FG22-86PC90507** | **California Univ., Berkeley (USA). Coll. of Engineering** | |
| | 12:36318 | DOE/PC/90507—T3 |
| **FG22-86PC90514** | **Illinois Univ., Urbana (USA). Dept. of Civil Engineering** | |
| | 12:36327 | DOE/PC/90514—T3 |
| **FG22-86PC90519** | **New Mexico Univ., Albuquerque (USA). Dept. of Chemistry** | |
| | 12:36319 | DOE/PC/90519—T2 |
| **FG22-86PC90529** | **Brown Univ., Providence, RI (USA). Div. of Engineering** | |
| | 12:36271 | DOE/PC/90529—2 |
| **FG22-86PC90536** | **Utah Univ., Salt Lake City (USA)** | |
| | 12:36237 | DOE/PC/90536—T3 |
| **FG22-86PC90538** | **Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering** | |
| | 12:36238 | DOE/PC/90538—3 |
| **FG22-86PC90909** | **Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining** | |
| | 12:36272 | DOE/PC/90909—T3 |
| **FG22-86PC90961** | **Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Mechanical and Aerospace Engineering** | |
| | 12:37493 | DOE/PC/90961—T3 |
| **NAS-7-100-956985** | **Electrink, Inc., San Diego, CA (USA)** | |
| | 12:37336 | DOE/JPL/956985—1 |
| **W-31-109-ENG-38** | **Argonne National Lab., Argonne, IL 60439** | |
| | 12:36678 | Journal of Solar Energy Engineering 109 NO. 2. 156-160 (May 1987). |
| | **Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research** | |
| | 12:36855 | NUREG/CP—0082-Vol.4(Feb 1987). |
| | 12:37246 | Journal of Chemical Physics 87 NO. 4. 2278-2281 (15 Aug 1987). |
| | 12:37252 | Physical Review Letters 59 NO. 2. 232-235 (13 Jul 1987). |
| | 12:37306 | Journal of Nuclear Materials 148 NO. 2. 166-170 (Apr 1987). |
| | 12:37533 | Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometer |
| **W-7405-ENG-26** | **Oak Ridge National Lab., TN** | |
| | 12:36776 | Annals of Nuclear Energy 11 NO. 1-2. 89 (1984). |
| **W-7405-ENG-36** | **Los Alamos National Lab., NM (USA)** | |
| | 12:36519 | LA—10929-MS |
| | 12:36520 | LA-UR—87-2252 |
| | 12:36560 | LA-UR—87-1952 |
| | 12:36561 | LA-UR—87-2116 |
| | 12:36562 | LA-UR—87-2117 |
| | 12:36684 | LA-UR—87-1531 |
| | 12:36803 | LA-UR—87-1000 |
| | 12:36805 | NUREG/CR—4892 |
| | 12:36821 | LA—10625-MS-Rev. |
| | 12:37221 | LA-UR—87-2134 |
| | 12:37222 | LA-UR—87-2160 |
| | 12:37223 | LA-UR—87-2198 |
| | 12:37300 | LA-UR—87-1673 |
| | 12:37400 | LA-UR—87-1739 |
| | 12:37483 | LA-UR—87-1535 |
| | 12:37484 | LA-UR—87-1714 |
| | 12:37581 | LA—10874 |
| | 12:37582 | LA-UR—87-1964 |
| | 12:37594 | LA—11059-MS |
| | 12:37711 | LA—10992-ENV |
| | 12:37850 | NUREG/CR—4615-Vol.2 |
| | 12:37959 | LA-UR—87-1748 |
| | 12:38015 | LA-tr—87-13(1987). |
| | 12:38298 | LA—10989-T |
| | **Illinois Univ., Urbana (USA). Dept. of Physics** | |
| | 12:38306 | LA-UR—87-2119 |
| | **Los Alamos National Lab., NM (USA)** | |
| | 12:38340 | LA-UR—87-1544 |
| | 12:38341 | LA-UR—87-1561 |
| | 12:38386 | Review of Scientific Instruments 58 NO. 8. 1401-1405 (Aug 1987). |
| | 12:38396 | LA-UR—87-2107 |
| **W-7405-ENG-48** | **Lawrence Livermore National Lab., CA (USA)** | |
| | 12:36438 | UCID—19348-Rev.1 |
| | 12:36470 | UCID—16986-87 |
| | 12:36481 | UCRL—96314 |
| | 12:36572 | UCRL—96407 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| | 12:36603 | UCRL—95798 |
| | 12:36931 | UCID—20466 |
| | 12:36932 | UCID—20475 |
| | 12:37188 | Energy and Technology Review (Livermore, CA) 1-8 (Jan-Feb 1987). |
| | 12:37189 | Energy and Technology Review (Livermore, CA) 9-11 (Jan-Feb 1987). |
| | 12:37190 | Energy and Technology Review (Livermore, CA) 23-30 (Jan-Feb 1987). |
| | 12:37191 | Energy and Technology Review (Livermore, CA) 31-45 (Jan-Feb 1987). |
| | 12:37192 | Energy and Technology Review (Livermore, CA) 50-59 (Jan-Feb 1987). |
| | 12:37193 | Energy and Technology Review (Livermore, CA) 46-49 (Jan-Feb 1987). |
| | 12:37195 | Energy and Technology Review (Livermore, CA) 12-22 (Jan-Feb 1987). |
| | 12:37197 | UCID—20622-87-2 |
| | 12:37243 | UCID—20676 |
| | 12:37244 | UCRL—96643 |
| | 12:37245 | UCRL—96787 |
| | 12:37256 | UCRL-Trans—12178(Apr 1987). |
| | 12:37260 | Scripta Metallurgica 21 NO. 1. 65-70 (Jan 1987). |
| | 12:37381 | UCRL—96796 |
| | 12:37422 | Journal of Chemical and Engineering Data 32 NO. 1. 85-91 (Jan 1987). |
| | 12:37423 | Journal of Chemical and Engineering Data 32 NO. 1. 92-97 (Jan 1987). |
| | 12:37447 | UCID—19080-86 |
| | 12:37466 | UCID—21073 |
| | 12:37467 | UCID—21083 |
| | 12:37468 | UCRL—96021 |
| | 12:37469 | UCRL—96629 |
| | 12:37486 | UCID—20682 |
| | 12:37487 | UCRL—93796 |
| | 12:37488 | UCRL—96579 |
| | 12:37502 | UCRL—96443 |
| | 12:37509 | UCRL—94791 |
| | 12:37518 | UCID—21075 |
| | 12:37523 | UCRL—96437 |
| | 12:37584 | UCRL—15902 |
| | 12:37585 | UCRL—94049 |
| | 12:37706 | UCRL—15916 |
| | 12:37728 | UCRL—96243 |
| | **BioSystems Analysis, Inc., Santa Cruz, CA (USA)** | |
| | 12:37828 | UCRL—15873 |
| | **Lawrence Livermore National Lab., CA (USA)** | |
| | 12:37852 | UCID—20754 |
| | 12:37853 | UCID—21031 |
| | 12:38007 | UCRL—96644 |
| | 12:38017 | UCRL—95561 |
| | 12:38048 | UCRL—96585 |
| | **Washington Univ., St. Louis, MO (USA). McDonnell Center for the Space Sciences** | |
| | 12:38070 | UCRL—96725 |
| | **Naval Surface Weapons Center, Silver Spring, MD (USA)** | |
| | 12:38104 | UCRL—96763 |
| | **Lawrence Livermore National Lab., CA (USA)** | |
| | 12:38198 | UCRL—92902 |
| | 12:38302 | UCID—21101 |
| | 12:38356 | UCRL—94086 |
| | 12:38358 | Physics of Fluids 30 NO. 8. 2442-2449 (Aug 1987). |
| | 12:38383 | UCRL—92353 |
| | 12:38384 | UCRL—93569-Rev.1 |
| | 12:38385 | UCRL—94346-Rev.1 |
| | 12:38400 | UCID—21106 |
| W-7405-ENG-82 | **Ames LaboratoryU.S. Department of Energy, Energy & Mineral Resources Research Institute, Iowa State** | |
| | 12:37250 | Physical Review Letters 59 NO. 3. 379-379 (20 Jul 1987). |
| | **Iowa State Univ. of Science and Technology, Ames (USA)** | |
| | 12:37274 | (1986). |
| | 12:37275 | (1986). |
| | **Ames Lab., IA (USA)** | |
| | 12:37337 | IS-T—1279 |
| | 12:37338 | IS-T—1281 |
| | 12:37353 | Physical Review Letters 59 NO. 3. 296-299 (20 Jul 1987). |
| | **Iowa State Univ. of Science and Technology, Ames (USA)** | |
| | 12:37366 | (1986). |
| | **Ames Lab., IA (USA)** | |
| | 12:37397 | IS-T—1292 |
| | 12:37398 | IS-T—1293 |
| | 12:37399 | IS-T—1294 |
| | 12:37458 | IS-T—1276 |
| | **Iowa State Univ. of Science and Technology, Ames (USA)** | |
| | 12:38097 | (1986). |
| | 12:38154 | (1986). |
| | **Texas Univ., Austin (USA). Center for Particle Theory** | |
| | 12:38163 | DOE/ER/40200—091 |
| | 12:38164 | DOE/ER/40200—092 |
| | 12:38199 | Physical Review [Section] D: Particles and Fields 36 NO. 3. 713-718 (1 Aug 1987). |
| W-31109-ENG-38 | **Argonne National Lab., IL (USA)** | |
| | 12:36232 | CONF-861063—7 |
| | 12:36294 | CONF-870410—31 |
| | 12:36351 | CONF-870540—1 |
| | 12:36352 | CONF-870540—2 |
| | 12:36416 | CONF-870137—2 |
| | 12:36501 | CONF-870306—61 |
| | 12:36503 | CONF-870812—20 |
| | 12:36574 | CONF-870804—18 |
| | 12:36622 | CONF-870497—2 |
| | 12:36623 | CONF-870666—1 |
| | 12:36701 | CONF-870711—5 |
| | 12:36782 | ANL—87-2 |
| | 12:36785 | CONF-870102—13-FP |
| | 12:36799 | NUREG/CR—4964 |
| | 12:36801 | CONF-860856—13 |
| | 12:36818 | CONF-861102—35 |
| | 12:36824 | CONF-861204—9 |
| | 12:36941 | CONF-870804—13 |
| | 12:36942 | CONF-870804—14 |
| | 12:36993 | CONF-8703148—1 |
| | 12:37005 | CONF-870664—2 |
| | 12:37009 | CONF-870172—3 |
| | 12:37010 | CONF-870804—16 |
| | 12:37016 | ANL/CNSV-TM—184 |
| | 12:37017 | ANL/CNSV-TM—185 |
| | 12:37018 | ANL/ES—150 |
| | 12:37024 | CONF-870564—1 |
| | 12:37153 | ANL/MCT—87-1 |
| | 12:37154 | CONF-870366—1 |
| | 12:37194 | CONF-870233—2 |
| | 12:37203 | CONF-861076—7 |
| | 12:37204 | CONF-870142—13 |
| | 12:37205 | CONF-870142—14 |
| | 12:37206 | CONF-870142—15 |
| | 12:37208 | CONF-870314—11 |
| | 12:37209 | CONF-870388—11 |
| | 12:37216 | CONF-8704163—-1 |
| | **Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering** | |
| | 12:37283 | CONF-860914—34 |
| | **Argonne National Lab., IL (USA)** | |
| | 12:37284 | CONF-870172—2 |
| | 12:37285 | CONF-870172—4 |
| | 12:37286 | CONF-870388—12 |
| | 12:37287 | CONF-870438—27 |

| Contract No. | Abstract No. | Report No. |
|---|---|---|
| **National Bureau of Standards, Boulder, CO (USA)** | | |
| | 12:37288 | CONF-870438—28 |
| **Argonne National Lab., IL (USA)** | | |
| | 12:37292 | CONF-8705103—6 |
| | 12:37293 | CONF-8705103—7 |
| | 12:37370 | CONF-870498—8 |
| | 12:37387 | CONF-870541—2 |
| | 12:37389 | CONF-870802—8 |
| | 12:37390 | CONF-870816—22 |
| | 12:37436 | ANL—87-18 |
| | 12:37437 | CONF-870661—7-Vugraphs |
| | 12:37527 | CONF-870804—17 |
| | 12:37824 | CONF-870297—1 |
| | 12:37848 | CONF-8704123—2 |
| | 12:37855 | CONF-870410—33 |
| | 12:37957 | CONF-8611165—1 |
| | 12:38110 | ANL-HEP-CP—87-31 |
| | 12:38111 | ANL-HEP-CP—87-49 |
| | 12:38214 | ANL-HEP-CP—87-15 |
| | 12:38233 | CONF-870501—6 |
| | 12:38265 | ANL-HEP-CP—87-45 |
| | 12:38296 | CONF-870588—2 |
| | 12:38322 | CONF-8610280—1 |
| | 12:38370 | CONF-870422—5 |

# REPORT NUMBER INDEX

The numbers assigned to reports cited in this publication appear in the first column of the index. Cross reference information and/or availability are included as appropriate. Abbreviations used in the availability column are elaborated at the end of the index. To expedite the filling of orders for reports from NTIS and OSTI, a file number in the form DE82000001 or TI82000001 appears in column 3. File numbers with DE prefixes may be used in ordering from both NTIS and OSTI. Numbers with TI prefixes are valid at OSTI only. Requesters are urged to use this file number where provided. In column 4, one or more DOE distribution categories are indicated, e.g., STD-10, MN-25. STD indicates distribution was made in full-size copy; MN indicates microcopy distribution; ND indicates no distribution was made. These category numbers are included to assist DOE librarians in responding to requests for reports in their collections. The UC (Unclassified Distribution Categories) are defined in DOE/TIC-4500, available from OSTI. The citation numbers are given in column 5. NOTE: DOE attempts to disseminate its information as broadly as possible. Even though a report may contain some degree of illegibility, it is believed that the report may still make a contribution. The presence of a 1, 2, or 3 following NTIS in the availability column denotes the document quality for microfiche (MF) and printed copy (PC) production: 1 = 92 to 95% legibility, available PC and MF; 2 = 88 to 91% legibility, available MF only; 3 = 87% or less legibility, available PC only. Employees of DOE or DOE contractors are urged to order from the Office of Scientific and Technical Information (OSTI); all others should order from the National Technical Information Service (NTIS).

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **AD-A-** | | | | |
| 179059/ 1/ XAB | NTIS, PC A02/MF A01 | | | 12:38080 |
| 179066/ 6/ XAB | NTIS, PC A02/MF A01 | | | 12:38088 |
| 179070/ 8/ XAB | NTIS, PC A08/MF A01 | | | 12:37586 |
| 179071/ 6/ XAB | NTIS, PC A10/MF A01 | | | 12:38401 |
| 179076/ 5/ XAB | NTIS, PC A05/MF A01 | | | 12:37837 |
| 179086/ 4/ XAB | NTIS, PC A04/MF A01 | | | 12:36940 |
| 179109/ 4/ XAB | NTIS, PC A06/MF A01 | | | 12:37324 |
| 179114/ 4/ XAB | NTIS, PC A05/MF A01 | | | 12:37587 |
| 179134/ 2/ XAB | NTIS, PC A02/MF A01 | | | 12:37325 |
| 179136/ 7/ XAB | NTIS, PC A03/MF A01 | | | 12:38081 |
| 179137/ 5/ XAB | NTIS, PC A02/MF A01 | | | 12:38089 |
| 179142/ 5/ XAB | NTIS, PC A08/MF A01 | | | 12:37015 |
| 179144/ 1/ XAB | NTIS, PC A04/MF A01 | | | 12:38098 |
| 179146/ 6/ XAB | NTIS, PC A07/MF A01 | | | 12:37278 |
| 179148/ 2/ XAB | NTIS, PC A02/MF A01 | | | 12:37448 |
| 179154/ 0/ XAB | NTIS, PC A02/MF A01 | | | 12:38090 |
| 179163/ 1/ XAB | NTIS, PC A03/MF A01 | | | 12:37185 |
| 179164/ 9/ XAB | NTIS, PC A11/MF A01 | | | 12:37449 |
| 179167/ 2/ XAB | NTIS, PC A03/MF A01 | | | 12:37279 |
| 179174/ 8/ XAB | NTIS, PC A03/MF A01 | | | 12:38082 |
| 179184/ 7/ XAB | NTIS, PC A06/MF A01 | | | 12:38083 |
| 179209/ 2/ XAB | NTIS, PC A05/MF A01 | | | 12:38099 |
| 179212/ 6/ XAB | NTIS, PC A05/MF A01 | | | 12:38100 |
| 179214/ 2/ XAB | NTIS, PC A06/MF A01 | | | 12:37326 |
| 179220/ 9/ XAB | NTIS, PC A10/MF A01 | | | 12:38011 |
| 179224/ 1/ XAB | NTIS, PC A02/MF A01 | | | 12:38084 |
| 179226/ 6/ XAB | NTIS, PC A07/MF A01 | | | 12:38091 |
| 179232/ 4/ XAB | NTISMF A01 | | | 12:37327 |
| 179243/ 1/ XAB | NTIS, PC A07/MF A01 | | | 12:36956 |
| 179245/ 6/ XAB | NTIS, PC A05/MF A01 | | | 12:37198 |
| 179258/ 9/ XAB | NTIS, PC A04/MF A01 | | | 12:38085 |
| 179264/ 7/ XAB | NTIS, PC A02/MF A01 | | | 12:37199 |
| 179269/ 6/ XAB | NTIS, PC A02/MF A01 | | | 12:37528 |
| 179272/ 0/ XAB | NTIS, PC A04/MF A01 | | | 12:37580 |
| 179273/ 8/ XAB | NTIS, PC A02/MF A01 | | | 12:36937 |
| 179275/ 3/ XAB | NTIS, PC A02/MF A01 | | | 12:38012 |
| 179286/ 0/ XAB | NTIS, PC A07/MF A01 | | | 12:37599 |
| 179289/ 4/ XAB | NTIS, PC A07/MF A01 | | | 12:37200 |
| 179298/ 5/ XAB | NTIS, PC A04/MF A01 | | | 12:37186 |
| 179303/ 3/ XAB | NTIS, PC A05/MF A01 | | | 12:38402 |
| 179323/ 1/ XAB | NTIS, PC A03/MF A01 | | | 12:38416 |
| 179331/ 4/ XAB | NTIS, PC A02/MF A01 | | | 12:38050 |
| 179337/ 1/ XAB | NTIS, PC A03/MF A01 | | | 12:36461 |
| 179346/ 2/ XAB | NTIS, PC A02/MF A01 | | | 12:37450 |
| 179348/ 8/ XAB | NTIS, PC A03/MF A01 | | | 12:36957 |
| 179353/ 8/ XAB | NTIS, PC A02/MF A01 | | | 12:37007 |
| 179359/ 5/ XAB | NTIS, PC A02/MF A01 | | | 12:38417 |
| 179366/ 0/ XAB | NTIS, PC A08/MF A01 | | | 12:38293 |
| 179374/ 4/ XAB | NTIS, PC A02/MF A01 | | | 12:38086 |
| 179377/ 7/ XAB | NTIS, PC A06/MF A01 | | | 12:37597 |
| 179384/ 3/ XAB | NTIS, PC A10/MF A01 | | | 12:38403 |
| 179390/ 0/ XAB | NTIS, PC A04/MF A01 | | | 12:38092 |
| 179399/ 1/ XAB | NTIS, PC A02/MF A01 | | | 12:37472 |
| 179407/ 2/ XAB | NTIS, PC A03/MF A01 | | | 12:38404 |
| 179416/ 3/ XAB | NTISMF A01 | | | 12:37588 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 179430/ 4/ XAB | NTIS, PC A04/MF A01 | | | 12:38018 |
| 179474/ 2/ XAB | NTIS, PC A03/MF A01 | | | 12:38405 |
| 179491/ 6/ XAB | NTIS, PC A03/MF A01 | | | 12:36620 |
| 179510/ 3/ XAB | NTIS, PC A06/MF A01 | | | 12:38307 |
| 179513/ 7/ XAB | NTIS, PC A02/MF A01 | | | 12:38051 |
| 179516/ 0/ XAB | NTIS, PC A16/MF A01 | | | 12:37451 |
| 179527/ 7/ XAB | NTIS, PC A04/MF A01 | | | 12:38319 |
| 179539/ 2/ XAB | NTIS, PC A04/MF A01 | | | 12:38041 |
| 179545/ 9/ XAB | NTIS, PC A02/MF A01 | | | 12:38052 |
| 179560/ 8/ XAB | NTISMF A01 | | | 12:37589 |
| 179573/ 1/ XAB | NTIS, PC A06/MF A01 | | | 12:38294 |
| 179577/ 2/ XAB | NTIS, PC A06/MF A01 | | | 12:38406 |
| 179584/ 8/ XAB | NTIS, PC A05/MF A01 | | | 12:38053 |
| 179585/ 5/ XAB | NTIS, PC A03/MF A01 | | | 12:38093 |
| 179604/ 4/ XAB | NTIS, PC A02/MF A01 | | | 12:37452 |
| 179606/ 9/ XAB | NTIS, PC A03/MF A01 | | | 12:37201 |
| 179616/ 8/ XAB | NTIS, PC A04/MF A01 | | | 12:37473 |
| 179650/ 7/ XAB | NTIS, PC A02/MF A01 | | | 12:38054 |
| 179664/ 8/ XAB | NTIS, PC A02/MF A01 | | | 12:38055 |
| 179671/ 3/ XAB | NTIS, PC A02/MF A01 | | | 12:37280 |
| 179685/ 3/ XAB | NTIS, PC A05/MF A01 | | | 12:36411 |
| 179688/ 7/ XAB | NTIS, PC A02/MF A01 | | | 12:37900 |
| 179698/ 6/ XAB | NTIS, PC A03/MF A01 | | | 12:38056 |
| 180111/ 7/ XAB | NTIS, PC A02/MF A01 | | | 12:38013 |
| 995462/ 9/ XAB | NTIS, PC A05/MF A01 | | | 12:37590 |
| **AD-B-** | | | | |
| 090882/ 2/ XAB | NTIS, PC A09/MF A01 | | | 12:37591 |
| 090883/ 0/ XAB | NTIS, PC A20/MF A01 | | | 12:37592 |
| **ADL-** | | | | |
| 54141 | *See* AD-A-179076/5/XAB | | | 12:37837 |
| **AEEW-M-** | | | | |
| 2352 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -92a | 12:36368 |
| **AEEW-R-** | | | | |
| 2114 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -92a | 12:36369 |
| 2171 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -92a | 12:36370 |
| **AERE-R-** | | | | |
| 10812-Rev. | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87900761 | MN -79a | 12:37576 |
| **AFGL-TR-** | | | | |
| 87-0116 | *See* AD-A-179059/1/XAB | | | 12:38080 |
| 87-0120 | *See* AD-A-179224/1/XAB | | | 12:38084 |
| **AFIT/GA/AA-** | | | | |
| 86D-4 | *See* AD-A-179209/2/XAB | | | 12:38099 |
| **AFIT/GAE/AA-** | | | | |
| 86D-6 | *See* AD-A-179214/2/XAB | | | 12:37326 |
| 86D-10 | *See* AD-A-179109/4/XAB | | | 12:37324 |
| **AFIT/GCE/ENG-** | | | | |
| 86D-2 | *See* AD-A-179384/3/XAB | | | 12:38403 |
| **AFIT/GCS/ENG-** | | | | |
| 86D-10 | *See* AD-A-179577/2/XAB | | | 12:38406 |
| 86D-17 | *See* AD-A-179071/6/XAB | | | 12:38401 |
| **AFIT/GE/ENG-** | | | | |
| 87M-5 | *See* AD-A-179510/3/XAB | | | 12:38307 |
| **AFIT/GEP/ENP-** | | | | |
| 86D-3 | *See* AD-A-179212/6/XAB | | | 12:38100 |
| 86D-5 | *See* AD-A-179390/0/XAB | | | 12:38092 |
| 86D-11 | *See* AD-A-179232/4/XAB | | | 12:37327 |
| **AFIT/GNE/ENP-** | | | | |
| 86D-1 | *See* AD-A-179114/4/XAB | | | 12:37587 |
| 87M-7 | *See* AD-A-179070/8/XAB | | | 12:37586 |
| **AGES-** | | | | |
| 861218 | *See* PB-87-184859/XAB | | | 12:36970 |
| **AIAA-** | | | | |
| 87-9081 | *See* DOE/NASA/17088-5 | DE87011605 | STD -11 | 12:37012 |
| **ANL-** | | | | |
| 87-2 | NTIS, PC A14/MF A01; 1 (GPO Dep.) | E 1.99: DE87011236 | STD -78 | 12:36782 |
| 87-18 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87011998 | STD -70A | 12:37436 |
| **ANL/CNSV-TM-** | | | | |
| 184 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87011237 | MN -95d | 12:37016 |
| 185 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: DE87011235 | MN -95d | 12:37017 |
| **ANL/EES-TM-** | | | | |
| 332 | *See* NUREG/CR-4964 | TI87010608 | MN -78 | 12:36799 |
| **ANL/ES-** | | | | |
| 150 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87011898 | MN -95d | 12:37018 |
| **ANL-HEP-CP-** | | | | |
| 87-15 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011482 | MN -34D | 12:38214 |
| 87-31 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011405 | MN -34D | 12:38110 |
| 87-45 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: DE87011484 | MN -34D | 12:38265 |
| 87-49 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011541 | MN -34D | 12:38111 |
| **ANL/MCT-** | | | | |
| 87-1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011129 | MN -95f | 12:37153 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| **ARCCB-TR-** | | | | | |
| 87003 | *See* AD-A-179269/6/XAB | | | | 12:37528 |
| **BARC-** | | | | | |
| 1278 | NTIS (US Sales Only), PC A02; 3 | | DE87900808 | MN -38 | 12:37510 |
| **BC-TM-TCFE-** | | | | | |
| 547-DFS-86-3 | British Coal HQ Technical Dept. Library, Stanhope-Bretby, DE15 0QD, United Kingdom | | | | 12:36339 |
| **BFE-R-** | | | | | |
| 86-04 | NTIS PC E09; Available from NTIS as TIB/B87-07077 | | | ND -51 | 12:37817 |
| **BFR-D-** | | | | | |
| 5-1986 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87752391 | MN -95d | 12:37019 |
| **BFR-G-** | | | | | |
| 10-1986 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87752393 | MN -95d | 12:37020 |
| **BFR-R-** | | | | | |
| 10-1986 | NTIS (US Sales Only), PC A06/MF A01; 1 | | DE87752395 | MN -95d | 12:37021 |
| 38-1986 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87752392 | MN -95d | 12:37022 |
| 43-1986 | NTIS (US Sales Only), PC A05; 3 | | DE87752394 | MN -59A | 12:36680 |
| **BIOLOGICAL-** | | | | | |
| 85(1.10) | *See* PB-87-179115/XAB | | | | 12:37998 |
| **BM-B-** | | | | | |
| 688 | *See* PB-87-183067/XAB | | | | 12:37672 |
| **BM-IC-** | | | | | |
| 9109 | *See* PB-87-188751/XAB | | | | 12:36342 |
| 9116 | *See* PB-87-189817/XAB | | | | 12:36343 |
| **BM-RI-** | | | | | |
| 9043 | *See* PB-87-171377/XAB | | | | 12:36366 |
| **BMFT-FB-T-** | | | | | |
| 86-125 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87770174 | MN -69 | 12:37521 |
| 86-131 | NTIS (US Sales Only), PC A11/MF A01; 1 | | DE87770173 | MN -107 | 12:36325 |
| 86-136 | NTIS (US Sales Only), PC A07/MF A01; 1 | | DE87770172 | MN -61A | 12:36621 |
| 86-147 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87770171 | MN -95e | 12:36580 |
| 86-158 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87770170 | MN -95e | 12:36596 |
| **BMI-** | | | | | |
| 2120-Vol.5 | *See* NUREG/CR-4082-Vol.5 | | TI87900596 | MN -80 | 12:36804 |
| **BMI/ONWI-** | | | | | |
| 636 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010239 | STD -70 | 12:36496 |
| 638 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010245 | STD -70 | 12:37818 |
| 640 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011006 | STD -70 | 12:37854 |
| 643 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011694 | STD -70 | 12:36497 |
| 646 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012321 | STD -70 | 12:36498 |
| 647 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012320 | STD -70 | 12:36499 |
| **BMU-** | | | | | |
| 1986-111 | NTIS PC E15; Available from NTIS as TIB/B87-06946 | | | ND -25 | 12:37202 |
| 1986-134 | NTIS PC E11; Available from NTIS as TIB/B87-04720 | | | ND -80 | 12:36822 |
| **BNL-** | | | | | |
| 35667 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011301 | MN -11 | 12:37767 |
| 39456 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008198 | MN -11 | 12:37709 |
| 39457 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008203 | MN -11 | 12:37600 |
| 39507 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008201 | MN -80 | 12:36779 |
| 39508 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008196 | MN -80 | 12:36780 |
| 39509 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008446 | MN -80 | 12:36781 |
| 39593 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010053 | MN -28 | 12:37540 |
| 39605 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010056 | MN -20 | 12:38320 |
| 39657 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010050 | MN -34C | 12:38112 |
| 39661 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010071 | MN -34D | 12:38113 |
| 39662 | *See* BNL-39665 | E 1.99: | DE87010069 | MN -34D | 12:38115 |
| 39663 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010042 | MN -34D | 12:38114 |
| 39665 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010069 | MN -34D | 12:38115 |
| 39697 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010062 | MN -80 | 12:36784 |
| 39723 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010448 | MN -34C | 12:38237 |
| 39724 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010041 | MN -48 | 12:37874 |
| 39747 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87010045 | MN -34D | 12:38215 |
| 39765 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010760 | MN -34D | 12:38155 |
| 39805 | NTIS, PC A02; 3 | | DE87010753 | MN -34 | 12:38295 |
| 39822 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010763 | MN -15 | 12:36557 |
| 39830 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87011291 | MN -13 | 12:38418 |
| 39866 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010790 | MN -48 | 12:37937 |
| 39876 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011300 | MN -13 | 12:38407 |
| 39905 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011304 | MN -48 | 12:37873 |
| 39924 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012123 | MN -25 | 12:37328 |
| 52042 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012307 | STD -70B | 12:36500 |
| 52052 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012067 | STD -11 | 12:36958 |
| 52071 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011897 | MN -11 | 12:38049 |
| **BNL-NUREG-** | | | | | |
| 39134 | NTIS MF A01; 2 | | TI87005258 | MN -80 | 12:36823 |
| 39849 | NTIS, PC A02/MF A01 - GPO | | TI87010755 | MN -78 | 12:36811 |
| 52066 | *See* NUREG/CR-4897 | | TI87011275 | MN -70B | 12:36521 |
| **BROWN/HET-** | | | | | |
| 630 | *See* DOE/ER/03130-630 | E 1.99: | DE87012064 | MN -34D | 12:38158 |
| **CA/DOH/AIHL/SP-** | | | | | |
| 40 | *See* PB-87-182077/XAB | | | | 12:37667 |

| *Report Number* | *Availability Source* | *File Number* | | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|---|
| **CAL-** | | | | | |
| 1629 | *See* AD-A-179331/4/XAB | | | | 12:38050 |
| **CCMS-** | | | | | |
| 6-08 | NTIS, PC A11/MF A01 | | | | 12:37329 |
| **CEA-CONF-** | | | | | |
| 8619 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87751790 | MN -63 | 12:37330 |
| 8717 | NTIS (US Sales Only), PC A02/MF A01 | | DE87751773 | MN -62 | 12:36654 |
| **CEA-D-** | | | | | |
| 347 | British Library, Boston Spa, Wetherby, West Yorks | | | ND -95e | 12:37104 |
| **CEA-DPh-G-LLB-SDN-** | | | | | |
| 86-34 | *See* CEA-CONF-8619 | | DE87751790 | MN -63 | 12:37330 |
| **CEBAF-** | | | | | |
| 85-003 | *See* DOE/ER/40150-2 | E 1.99: | DE87008679 | MN -34C | 12:38234 |
| 85-004 | *See* DOE/ER/40150-1 | E 1.99: | DE87008676 | MN -28 | 12:37529 |
| **CEBAF-PR-** | | | | | |
| 86-001 | *See* DOE/ER/40150-7 | | DE87008678 | MN -28 | 12:37541 |
| 86-002 | *See* DOE/ER/40150-27 | | DE87008673 | MN -28 | 12:37542 |
| 86-003 | *See* DOE/ER/40150-8 | | DE87008674 | MN -28 | 12:37530 |
| 86-004 | *See* DOE/ER/40150-10 | | DE87008659 | MN -28 | 12:37548 |
| 86-007 | *See* DOE/ER/40150-12 | E 1.99: | DE87008662 | MN -34D | 12:38161 |
| 86-008 | *See* DOE/ER/40150-9 | E 1.99: | DE87008677 | MN -34C | 12:38235 |
| 86-009 | *See* DOE/ER/40150-13 | | DE87008671 | MN -28 | 12:37549 |
| 86-013 | *See* DOE/ER/40150-15 | E 1.99: | DE87008672 | MN -34C | 12:38230 |
| 87-002 | *See* DOE/ER/40150-22 | E 1.99: | DE87008491 | MN -34C | 12:38271 |
| 87-003 | *See* DOE/ER/40150-23 | E 1.99: | DE87008675 | MN -34C | 12:38272 |
| 87-004 | *See* DOE/ER/40150-24 | E 1.99: | DE87008666 | MN -28 | 12:37531 |
| 87-006 | *See* DOE/ER/40150-25 | | DE87008667 | MN -34D | 12:38124 |
| 87-017 | *See* DOE/ER/40150-29 | E 1.99: | DE87008664 | MN -28 | 12:37532 |
| **CGR/DC-** | | | | | |
| 12/ 86 | *See* AD-A-179243/1/XAB | | | | 12:36956 |
| **CI-FR-** | | | | | |
| 0102 | *See* N-87-20820 | | | | 12:37345 |
| **CMI-R-** | | | | | |
| 852243-2 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752488 | MN -131 | 12:36435 |
| 852310-3 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752489 | MN -122 | 12:36371 |
| 852310-5 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752490 | MN -121 | 12:36414 |
| 852310-6 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752491 | MN -121 | 12:36415 |
| 852330-8 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752492 | MN -124 | 12:36413 |
| 862333-3 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752493 | MN -131 | 12:36436 |
| **CONCAWE-** | | | | | |
| 1/ 87 | *See* PB-87-185849/XAB | | | | 12:36425 |
| 10/ 86 | *See* PB-87-176921/XAB | | | | 12:37647 |
| **CONF-690588-** | (Steel-strengthening mechanisms symposium, Zurich, Switzerland, 5-6 May 1969) | | | | |
| 1-Trans. | *See* UCRL-Trans-12178 | E 1.99: | DE87009118 | MN -25 | 12:37256 |
| **CONF-8006116-** | (Conference on chemistry and physics of coal utilization, Morgantown, WV, USA, 4 Jun 1980) | | | | |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011816 | MN -102 | 12:36234 |
| **CONF-830743-** | (Conference on energy statistics, Cambridge, UK, 6-9 Jul 1983) | | | | |
| | Statistician, 33: No. 1, 1-7(Mar 1984) | | | | 12:36979 |
| | Statistician, 33: No. 1, 143-150(Mar 1984) | | | | 12:36991 |
| | Statistician, 33: No. 1, 111-132(Mar 1984) | | | | 12:37004 |
| **CONF-8401120-** | (Workshop on mechanisms of compensatory response of fish populations, Palo Alto, CA, USA, 1 Jan 1984) | | | | |
| | *See* EPRI-EA-5202 | | TI87920470 | ND -11 | 12:36617 |
| **CONF-8406360-** | (14. Nordic meteorologist meeting, Tromsoe, Norway, 25-29 Jun 1984) | | | | |
| 1 | *See* NILU-F-18/84 | | DE87752500 | MN -11 | 12:37621 |
| **CONF-8408220-** | (Workshop on mechanisms of compensatory response of fish populations, Arlie, VA, USA, 1 Aug 1984) | | | | |
| | *See* EPRI-EA-5202 | | TI87920470 | ND -11 | 12:36617 |
| **CONF-850103-** | (2. symposium on space nuclear power systems, Albuquerque, NM, USA, 14-16 Jan 1985) | | | | |
| 16 | *See* HEDL-SA-3188 | E 1.99: | DE87010410 | MN -80 | 12:36788 |
| **CONF-8502155-** | (Workshop on mechanisms of compensatory response of fish populations, Rancho Santa Fe, CA, USA, 1 Feb 1985) | | | | |
| | *See* EPRI-EA-5202 | | TI87920470 | ND -11 | 12:36617 |
| **CONF-850318-** | (2. workshop on perspectives in nuclear physics at intermediate energies, Trieste, Italy, 25-29 Mar 1985) | | | | |
| 6 | *See* DOE/ER/40150-1 | E 1.99: | DE87008676 | MN -28 | 12:37529 |
| **CONF-8503120-** | (Hadronic probes and nuclear interactions conference, Tempe, AZ, USA, 11-14 Mar 1985) | | | | |
| 10 | *See* DOE/ER/40150-2 | E 1.99: | DE87008679 | MN -34C | 12:38234 |
| **CONF-8504305-** | (Recontres de Moriond conference on weak interactions, Les Arcs, France, 23 Apr 1985) | | | | |
| 1 | *See* UCRL-92902 | | DE87009587 | MN -34C | 12:38198 |
| **CONF-8506356-** | (International seminar on Soviet energy, Soderfors, Sweden, 6-7 Jun 1985) | | | | |
| | *See* STEV-1986-3 | | DE87752397 | MN -98 | 12:36987 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| CONF-8508235- | (IUFRO conference on inventoring and monitoring endangered forests, Zurich, Switzerland, 19-24 Aug 1985) | | | |
| | NTIS (US Sales Only), PC A16/MF A01; 1 | DE87752457 | MN -11 | 12:37768 |
| CONF-850925- | (3. international symposium on radiation physics, Ferrara, Italy, 30 Sep-4 Oct 1985) | | | |
| | Nucl. Instrum. Methods Phys. Res., Sect. A., 255: No. 1/2, 317-325(15 Mar 1987) | | | 12:37572 |
| | Nucl. Instrum. Methods Phys. Res., Sect. A., 255: No. 1/2, 207-212(15 Mar 1987) | | | 12:37573 |
| CONF-8509397- | (2. international workshop on atomic physics for ion fusion, Appleton, UK, 11-15 Sep 1985) | | | |
| 1 | *See* UCRL-92353 | E 1.99: DE87008755 | MN -21 | 12:38383 |
| CONF-851027- | (24. Hanford life sciences symposium on health and environmental research on complex organic mixtures, Richland, WA, USA, 21-24 Oct 1985) | | | |
| 12 | *See* DP-MS-86-149 | E 1.99: DE87006390 | MN -48 | 12:37808 |
| CONF-851047- | (International conference on alternative technologies for utilization of high sulphur coal, Columbus, OH, USA, 13-17 Oct 1985) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.9[illegible]: DE87011813 | MN -102 | 12:36228 |
| CONF-8510235- | (Workplace aerosol monitoring workshop, Napa, CA, USA, 28-30 Oct 1985) | | | |
| | *See* PNL-SA-14225 | E 1.99: DE87011680 | MN -41 | 12:36555 |
| CONF-8510450- | (Scientific colloquium of Sonderforschungsbereich 134 (petroleum technology - petroleum chemistry, Clausthal-Zellerfeld, F.R. Germany, 24-25 Oct 1985) | | | |
| Exc. | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752460 | MN -122 | 12:36375 |
| CONF-851115- | (American Nuclear Society winter meeting, San Francisco, CA, USA, 10-15 Nov 1985) | | | |
| 54 | *See* HEDL-SA-3359 | DE87010411 | MN -79 | 12:36815 |
| CONF-851123- | (American Institute of Chemical Engineers annual winter meeting, Chicago, IL, USA, 10-14 Nov 1985) | | | |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36286 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36287 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36288 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36289 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36290 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36350 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:36595 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:37430 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:37504 |
| 12 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011759 | MN -105 | 12:36760 |
| CONF-851217- | (Materials Research Society meeting, Boston, MA, USA, 2-7 Dec 1985) | | | |
| 70 | Elsevier Science Publishing Co., Vanderbilt Ave., New York, NY 10017 | TI87011649 | ND -25 | 12:37281 |
| CONF-860117- | (Los Angeles symposium and exhibition on optical and electro-optical engineering, Los Angeles, CA, USA, 19-24 Jan 1986) | | | |
| 17 | *See* UCRL-93796 | E 1.99: DE87008740 | MN -38 | 12:37487 |
| CONF-8601122- | (Combustion Engineering Association meeting on low temperature heat recovery, Leeds, UK, 14 Jan 1986) | | | |
| 1 | *See* CEA-D-347 | | ND -95e | 12:37104 |
| CONF-860292- | (Lake Louise winter institute in particle physics, Edmonton, Alberta, Canada, 16-22 Feb 1986) | | | |
| 5 | *See* SLAC-PUB-3928 | E 1.99: DE87010843 | MN -34D | 12:38145 |
| CONF-860303- | (13. annual energy technology conference and exposition (ET '86), Washington, DC, USA, 17-19 Mar 1986) | | | |
| 8 | *See* LBL-20896 | DE87010285 | MN -95d | 12:37073 |
| CONF-860340- | (115. American Institute of Mining, Metallurgical and Petroleum Engineers annual meeting, New Orleans, LA, USA, 2-6 Mar 1986) | | | |
| 17 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011811 | MN -102 | 12:36229 |
| CONF-860421- | (2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986) | | | |
| 75 | *See* HEDL-SA-3418 | A 1.99: DE87010412 | MN -20c | 12:37220 |
| CONF-8604194- | (International symposium on three-body force in the three-nucleon system, Washington, DC, USA, 24-26 Apr 1986) | | | |
| 9 | *See* DOE/ER/40150-12 | E 1.99: DE87008662 | MN -34D | 12:38161 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| CONF-860501- | (Conference on the science and technology of fast reactor safety, Channel Islands, UK, 12-16 May 1986) | | | |
| 25 | *See* HEDL-SA-3349 | E 1.99: DE87009972 | MN -79b | 12:36820 |
| CONF-860515- | (EPS conference on computational physics - computing in plasma physics, Partenkirchen, F.R. Germany, 13-16 May 1986) | | | |
| 5 | *See* UCRL-94086 | E 1.99: DE87009603 | MN -34 | 12:38356 |
| CONF-860575- | (2. conference on particle and nuclear physics, Lake Louise, Canada, 26-31 May 1986) | | | |
| 62 | *See* DOE/ER/40150-9 | E 1.99: DE87008677 | MN -34C | 12:38235 |
| CONF-8605163- | (Workshop on physics simulation at high energies, Madison, WI, USA, 5-16 May 1986) | | | |
| | World Sci. Publ. Co., Box 128, Farrer Rd., Singapore 9138 | TI87010800 | ND -34D | 12:38207 |
| CONF-8605268- | (JOWOG-12 meeting, Golden, CO, USA, 12-16 May 1986) | | | |
| 1 | *See* UCRL-94049 | E 1.99: DE87009602 | MN -45 | 12:37585 |
| CONF-860629- | (Linear accelerator conference, Stanford, CA, USA, 2-6 Jun 1986) | | | |
| 72 | *See* DOE/ER/40150-8 | DE87008674 | MN -28 | 12:37530 |
| 73 | *See* DOE/ER/40150-7 | DE87008678 | MN -28 | 12:37541 |
| 74 | *See* DOE/ER/40150-27 | DE87008673 | MN -28 | 12:37542 |
| 77 | *See* DOE/ER/40150-10 | DE87008659 | MN -28 | 12:37548 |
| 78 | *See* DOE/ER/40150-13 | DE87008671 | MN -28 | 12:37549 |
| CONF-8606201- | (Neutrino '86, Sendai, Japan, 3-8 Jun 1986) | | | |
| 7 | *See* BNL-39663 | E 1.99: DE87010042 | MN -34D | 12:38114 |
| CONF-8606241- | (3. Continuous Electron Beam Accelerator Facility summer school, Newport News, VA, USA, 23-27 Jun 1986) | | | |
| 8 | *See* DOE/ER/40150-15 | E 1.99: DE87008672 | MN -34C | 12:38230 |
| CONF-8606259- | (Theoretical Advanced Study Institute conference, Santa Cruz, CA, USA, 23 Jun-29 Jul 1986) | | | |
| 5 | *See* SLAC-PUB-4251 | E 1.99: DE87010542 | MN -34D | 12:38223 |
| CONF-8606304- | (Workshop on modeling of solute transport in the unsaturated zone, Los Alamos, NM, USA, 19-20 Jun 1986) | | | |
| Vol.2 | *See* NUREG/CR-4615-Vol.2 | TI87009181 | MN -70B | 12:37850 |
| CONF-8606313- | (NATO advanced study institute on cerebral blood flow and metabolism, L'Aguila, Italy, 2-14 Jun 1986) | | | |
| 1 | *See* BNL-39724 | E 1.99: DE87010041 | MN -48 | 12:37874 |
| CONF-8606323- | (13. annual conference Plasma Physics Group of the Institute of Physics, Oxford, UK, 26-28 Jun 1986) | | | |
| | Plasma Phys. Control. Fusion, 28: No. 12B, 1921-1930(Dec 1986) | | | 12:38390 |
| CONF-860736- | (14. SLAC summer institute on particle physics, Stanford, CA, USA, 28 Jul-8 Aug 1986) | | | |
| 16 | *See* SLAC-PUB-4287 | E 1.99: DE87010547 | MN -34D | 12:38146 |
| CONF-8607326- | (Summer school on techniques in experimental high energy physics, St. Croix, Virgin Islands, U.S., 1 Jul 1986) | | | |
| 1 | *See* LBL-23122 | E 1.99: DE87010260 | MN -34D | 12:38218 |
| CONF-8607327- | (3. Theoretical Advanced Study Institute, Santa Cruz, CA, USA, 1 Jul-1 Aug 1986) | | | |
| 1 | *See* LBL-23122 | E 1.99: DE87010260 | MN -34D | 12:38218 |
| CONF-860801- | (10. international coal preparation congress, Edmonton, Alberta, Canada, 31 Aug-5 Sep 1986) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011818 | MN -102 | 12:36230 |
| CONF-860826- | (National meeting of the American Institute of Chemical Engineers, Boston, MA, USA, 24-27 Aug 1986) | | | |
| 14 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011805 | MN -102 | 12:36231 |
| CONF-860856- | (Conference on review of progress in quantitative NDE, San Diego, CA, USA, 3-8 Aug 1986) | | | |
| 13 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87007009 | MN -80 | 12:36801 |
| CONF-860880- | (30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986) | | | |
| 54 | *See* UCRL-94791 | DE87009947 | MN -37 | 12:37509 |
| CONF-860883- | (Ceramic powder science and technology, Boston, MA, USA, 3-6 Aug 1986) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010904 | MN -25 | 12:37282 |
| CONF-860892- | (18. international conference on physics of semiconductors, Stockholm, Sweden, 11-15 Aug 1986) | | | |
| 5 | *See* CEA-CONF-8619 | DE87751790 | MN -63 | 12:37330 |
| CONF-860914- | (Applied superconductivity conference (ASC '86), Baltimore, MD, USA, 28 Sep-4 Oct 1986) | | | |
| 34 | NTIS, PC A02; 3 | DE87011403 | MN -25 | 12:37283 |
| CONF-860917- | (14. SOFT - symposium on fusion technology, Avignon, France, 8-12 Sep 1986) | | | |
| | *See* ENEA-RT-FUS-86-7 | DE87752631 | MN -20f | 12:38379 |
| CONF-860931- | (International conference on reliable fuels for liquid metal reactors, Tucson, AZ, USA, 7-11 Sep 1986) | | | |
| 23 | *See* HEDL-SA-3491 | E 1.99: DE87009966 | MN -79 | 12:36783 |

| *Report Number* | *Availability Source* | *File Number* | | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|---|
| CONF-8609126- | (Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions, Palo Alto, CA, USA, 3-5 Sep 1986) | | | | |
| | *See* EPRI-NP-5054-SR | | TI87920306 | ND -80 | 12:36826 |
| CONF-8609135- | (International symposium on muon-catalyzed fusion, Tokyo, Japan, 1-3 Sep 1986) | | | | |
| 8 | *See* BNL-39605 | E 1.99: | DE87010056 | MN -20 | 12:38320 |
| CONF-8609142- | (Lattice gauge theory meeting, Upton, NY, USA, 15-19 Sep 1986) | | | | |
| 6 | *See* BNL-39765 | E 1.99: | DE87010760 | MN -34D | 12:38155 |
| CONF-8609161- | (Meeting on delayed neutrons, Birmingham, UK, 15-19 Sep 1986) | | | | |
| 3 | *See* HEDL-SA-3530 | E 1.99: | DE87010726 | MN -34C | 12:38245 |
| CONF-8609178- | (Society of Mining Engineering of AIME fall meeting, St. Louis, MO, USA, 7-10 Sep 1986) | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011812 | MN -102 | 12:36298 |
| CONF-8609221- | (International school on low energy antiproton physics, Sicily, Italy, 27 Sep-3 Oct 1986) | | | | |
| 2 | *See* DESY-86-156 | | | ND -34D | 12:38156 |
| CONF-8609270- | (Seminar on evaluation of the solar thermal program, Sophia Antipolis, France, 16-19 Sep 1986) | | | | |
| 1 | *See* CEA-CONF-8717 | | DE87751773 | MN -62 | 12:36654 |
| CONF-8609296- | (Workshop on spin phenomena in hadronic interactions, Wuppertal, F.R. Germany, 15-17 Sep 1986) | | | | |
| 1 | *See* ANL-HEP-CP-87-31 | E 1.99: | DE87011405 | MN -34D | 12:38110 |
| CONF-861044- | (Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford, Richland, WA, USA, 21-23 Oct 1986) | | | | |
| 8 | *See* PNL-SA-14190 | E 1.99: | DE87011156 | MN -41 | 12:37932 |
| CONF-861063- | (American Society of Metals materials week, Lake Buena Vista, FL, USA, 6-9 Oct 1986) | | | | |
| 6 | *See* DP-MS-86-151 | E 1.99: | DE87010164 | MN -25 | 12:37218 |
| 7 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87004853 | MN -102 | 12:36232 |
| CONF-861076- | (Fall meeting of the Metallurgical Society of AIME, Orlando, FL, USA, 5-9 Oct 1986) | | | | |
| 7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011357 | MN -25 | 12:37203 |
| CONF-8610156- | (Plutonium/uranium chemical recovery operations conference, Aiken, SC, USA, 14-16 Oct 1986) | | | | |
| 3-Abst. | *See* DP-MS-86-164 | E 1.99: | DE87011251 | MN -10 | 12:36485 |
| CONF-8610239- | (Symposium celebrating 35 years of electron scattering in nuclear and particle science, Urbana, IL, USA, 23-24 Oct 1986) | | | | |
| 2 | *See* DOE/ER/40150-22 | E 1.99: | DE87008491 | MN -34C | 12:38271 |
| CONF-8610280- | (International workshop for eddy current code comparison, Tokyo, Japan, 20-21 Oct 1986) | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87004838 | MN -20 | 12:38322 |
| CONF-8610285- | (Heavy ion fusion symposium, Washington, DC, USA, 1 Oct 1986) | | | | |
| 1-Rev.1 | *See* UCRL-94346-Rev.1 | E 1.99: | DE87009607 | MN -21 | 12:38385 |
| CONF-8610288- | (2. fuel oil utilization workshop, Philadelphia, PA, USA, 7-9 Oct 1986) | | | | |
| | *See* EPRI-AP-5247 | | TI87920473 | ND -125 | 12:36429 |
| CONF-861102- | (American Nuclear Society and Atomic Industrial Forum joint meeting, Washington, DC, USA, 16-21 Nov 1986) | | | | |
| 35 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87004743 | MN -79 | 12:36818 |
| CONF-861106- | (IAEA international conference on plasma physics and controlled nuclear fusion research, Kyoto, Japan, 12-19 Nov 1986) | | | | |
| 27 | *See* DOE/ET/51013-206 | E 1.99: | DE87010005 | MN -20f | 12:38326 |
| CONF-861109- | (2. international daylighting conference: architecture and natural light, Long Beach, CA, USA, 5-7 Nov 1986) | | | | |
| 1 | *See* LBL-20545 | E 1.99: | DE87011091 | MN -95d | 12:37072 |
| CONF-861114- | (9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986) | | | | |
| | Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: 1087-1091(Apr 1987) | | | | 12:37533 |
| CONF-861131- | (6. intersociety cryogenics symposium, Miami Beach, FL, USA, 2-7 Nov 1986) | | | | |
| 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011819 | MN -102 | 12:36292 |
| 4 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011821 | MN -102 | 12:36233 |
| CONF-861146- | (AIChE winter annual meeting, Miami, FL, USA, 2-7 Nov 1986) | | | | |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | | 12:36284 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | | 12:36426 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | | 12:36471 |
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | | 12:36472 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| | American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017 | | | 12:37425 |
| CONF-8611106- | (Brookhaven National Laboratory regional utilities seminar life extension, energy/fuels and environment, Upton, NY, USA, 5-6 Nov 1986) | | | |
| 1 | *See* BNL-NUREG-39134 | TI87005258 | MN -80 | 12:36823 |
| CONF-8611147- | (8. international conference on NDE in the nuclear industry, Orlando, FL, USA, 17-19 Nov 1986) | | | |
| 1 | *See* UNI-SA-166 | E 1.99: DE87007840 | MN -80 | 12:36810 |
| CONF-8611161- | (American Physical Society meeting, San Diego, CA, USA, 4-8 Nov 1986) | | | |
| 1-Rev.1 | *See* UCRL-93569-Rev.1 | E 1.99: DE87008483 | MN -21 | 12:38384 |
| CONF-8611163- | (Water and Pollution Control Association of South Carolina fall conference, Myrtle Beach, SC, USA, 5-7 Nov 1986) | | | |
| 1 | *See* DP-MS-86-155 | DE87011175 | MN -11 | 12:37825 |
| CONF-8611165- | (Annual conference on fire research, Gaithersburg, MD, USA, 3-6 Nov 1986) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011353 | MN -41 | 12:37957 |
| CONF-8611166- | (Electric utility market research symposium, Kansas City, MO, USA, 5-7 Nov 1986) | | | |
| | *See* EPRI-EM-5175 | TI87920480 | ND -98E | 12:36995 |
| CONF-861204- | (4. Miami international symposium on multi-phase transport and particulate phenomena, Miami Beach, FL, USA, 15-17 Dec 1986) | | | |
| 9 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010646 | MN -78 | 12:36824 |
| CONF-861207- | (Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986) | | | |
| 109 | *See* PNL-SA-14497 | E 1.99: DE87011337 | MN -25 | 12:37302 |
| CONF-861277- | (Parity violation workshop - CEBAF, Newport News, VA, USA, 11 Dec 1986) | | | |
| 1 | *See* DOE/ER/40150-23 | E 1.99: DE87008675 | MN -34C | 12:38272 |
| CONF-861288- | (Indirect liquefaction contractors' conference, Monroeville, PA, USA, 2-4 Dec 1986) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011758 | MN -108 | 12:36581 |
| CONF-861291- | (Bilateral information meeting Hungary-Austria on forest decline, Seibersdorf, Austria, 1 Dec 1986) | | | |
| | *See* OEFZS-4389 | | ND -48 | 12:37989 |
| CONF-870102- | (4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987) | | | |
| 13-FP | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87006986 | MN -80 | 12:36785 |
| 17 | *See* BNL-39507 | E 1.99: DE87008201 | MN -80 | 12:36779 |
| 18 | *See* BNL-39508 | E 1.99: DE87008196 | MN -80 | 12:36780 |
| 19 | *See* SAND-87-0638C | E 1.99: DE87007864 | MN -80 | 12:36789 |
| 20 | *See* BNL-39509 | E 1.99: DE87008446 | MN -80 | 12:36781 |
| 25 | *See* BNL-39697 | E 1.99: DE87010062 | MN -80 | 12:36784 |
| CONF-870121- | (Meeting of the Division of Particles and Fields of the American Physical Society, Salt Lake City, UT, USA, 14-17 Jan 1987) | | | |
| 8 | *See* BNL-39657 | E 1.99: DE87010050 | MN -34C | 12:38112 |
| 9 | *See* BNL-39665 | E 1.99: DE87010069 | MN -34D | 12:38115 |
| 10 | *See* ANL-HEP-CP-87-15 | E 1.99: DE87011482 | MN -34D | 12:38214 |
| CONF-870132- | (LASE-13: pulse power for lasers conference, Los Angeles, CA, USA, 11-16 Jan 1987) | | | |
| 14 | *See* UCRL-96314 | E 1.99: DE87011557 | MN -22 | 12:36481 |
| CONF-870137- | (Transportation Research Board annual meeting, Washington, DC, USA, 13 Jan 1987, 13 Jan 1987) | | | |
| 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011477 | MN -98B | 12:36416 |
| CONF-870142- | (5. international conference on valence fluctuations, Bangalore, India, 5-9 Jan 1987) | | | |
| 13 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011476 | MN -25 | 12:37204 |
| 14 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011483 | MN -25 | 12:37205 |
| 15 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011487 | MN -25 | 12:37206 |
| CONF-870165- | (Workshop on electronuclear physics with internal targets, Stanford, CA, USA, 5-8 Jan 1987) | | | |
| 3 | *See* DOE/ER/40150-25 | DE87008667 | MN -34D | 12:38124 |
| 7 | *See* DOE/ER/40048-19-N7 | DE87011082 | MN -34C | 12:38268 |
| 8 | *See* SLAC-PUB-4323 | DE87011593 | MN -34D | 12:38197 |
| 9 | *See* ANL-HEP-CP-87-45 | E 1.99: DE87011484 | MN -34D | 12:38265 |
| CONF-870170- | (Workshop on a linear-collider B anti B factory, Los Angeles, CA, USA, 26-30 Jan 1987) | | | |
| 1 | *See* SLAC-PUB-4300 | E 1.99: DE87009893 | MN -34D | 12:38147 |
| CONF-870172- | (11. annual conference on composites, Cocoa Beach, FL, USA, 18-23 Jan 1987) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011478 | MN -25 | 12:37284 |
| 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011479 | MN -110 | 12:37009 |
| 4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011481 | MN -25 | 12:37285 |
| CONF-870173- | (Pikes Peak section of IEEE, Colorado Springs, CO, USA, 22 Jan 1987) | | | |
| 1 | *See* EGG-M-00387 | E 1.99: DE87009345 | MN -2 | 12:36975 |
| CONF-870174- | (5. meeting of the Building Thermal Materials Committee, Washington, DC, USA, 7 Jan 1987) | | | |
| 1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010604 | MN -95d | 12:37023 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **CONF-870177-** | (5. Oaxtepec nuclear physics symposium, Oaxtepec, Mexico, 5-8 Jan 1987) | | | |
| 1 | *See* LBL-23381 | E 1.99: DE87011213 | MN -34C | 12:38261 |
| **CONF-870178-** | (Workshop on supercomputer utilization in radiation effects modeling, San Diego, CA, USA, 21-23 Jan 1987) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87008775 | MN -25 | 12:37207 |
| **CONF-870204-** | (Society of Automotive Engineers international congress and expo, Detroit, MI, USA, 23-27 Feb 1987) | | | |
| | Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096 | | | 12:37167 |
| **CONF-870210-** | (10. energy sources technology conference and exhibition, Dallas, TX, USA, 15-18 Feb 1987) | | | |
| 1 | NTIS, PC A02; 3 | DE87004259 | MN -96 | 12:37160 |
| **CONF-870212-** | (Annual meeting and exhibition of the Society of Mining Engineers, Denver, CO, USA, 24-27 Feb 1987) | | | |
| 3 | NTIS, PC A02; 3 | DE87011817 | MN -102 | 12:36293 |
| **CONF-870233-** | (Annual meeting of American Association for the Advancement of Science, Chicago, IL, USA, 14-18 Feb 1987) | | | |
| 2 | NTIS, PC A02; 3 | DE87011701 | MN -2 | 12:37194 |
| **CONF-870255-** | (18. southeastern international conference on combinatorics: graph theory computing, Boca Raton, FL, USA, 23-27 Feb 1987) | | | |
| 2 | *See* SAND-87-0002C | E 1.99: DE87011860 | MN -13 | 12:38398 |
| **CONF-870272-** | (American Institute of Metallurgical Engineers annual meeting: light metals session, Denver, CO, USA, 22-26 Feb 1987) | | | |
| 4 | *See* BNL-39805 | DE87010753 | MN -34 | 12:38295 |
| **CONF-870278-** | (4. family of quarks and leptons international symposium, Santa Monica, CA, USA, 26-28 Feb 1987) | | | |
| 2 | *See* SLAC-PUB-4315 | E 1.99: DE87010313 | MN -34D | 12:38196 |
| 4 | *See* ANL-HEP-CP-87-49 | E 1.99: DE87011541 | MN -34D | 12:38111 |
| **CONF-870279-** | (Lake Louise winter institute, Alberta, Canada, 15-21 Feb 1987) | | | |
| 9 | *See* BNL-39661 | E 1.99: DE87010071 | MN -34D | 12:38113 |
| **CONF-870283-** | (BNL neutrino workshop, Upton, NY, USA, 5-7 Feb 1987) | | | |
| 7 | *See* BNL-39665 | E 1.99: DE87010069 | MN -34D | 12:38115 |
| **CONF-870292-** | (Magnetic Fusion Advisory Committee meeting, Atlanta, GA, USA, 24-25 Feb 1987) | | | |
| 1-Vugraphs | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87007926 | MN -20 | 12:38368 |
| **CONF-870293-** | (26. Schladming winter school in particle physics, Schladming, Austria, 17-27 Feb 1987) | | | |
| 1 | *See* SLAC-PUB-4259 | DE87010543 | MN -34D | 12:38310 |
| **CONF-870297-** | (10. international landfill gas symposium, West Palm Beach, FL, USA, 9-13 Feb 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011490 | MN -95e | 12:37824 |
| **CONF-870302-** | (Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987) | | | |
| 147 | *See* FNAL-TM-1444 | DE87009031 | STD -28 | 12:37543 |
| 169 | *See* SLAC-PUB-4221 | DE87009453 | MN -28 | 12:37557 |
| 170 | *See* SLAC-PUB-4217 | DE87009454 | MN -28 | 12:37556 |
| 172 | *See* LBL-22189 | DE87009548 | MN -28 | 12:37560 |
| 173 | *See* LBL-22193 | DE87009550 | MN -28 | 12:37561 |
| 175 | *See* SLAC-PUB-4178 | DE87009457 | MN -28 | 12:37554 |
| 176 | *See* SLAC-PUB-4209 | DE87009455 | MN -28 | 12:37555 |
| 184 | *See* BNL-39593 | E 1.99: DE87010053 | MN -28 | 12:37540 |
| **CONF-870306-** | (Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987) | | | |
| 47 | *See* EGG-M-29786 | DE87009398 | MN -70 | 12:36515 |
| 56 | *See* RHO-RE-SA-182 | E 1.99: DE87010688 | MN -70 | 12:36532 |
| 58 | *See* PNL-SA-14426 | E 1.99: DE87011138 | MN -70 | 12:36528 |
| 59 | *See* DP-MS-86-138 | DE87011219 | MN -70B | 12:36510 |
| 60 | *See* DP-MS-87-1 | E 1.99: DE87011228 | MN -70 | 12:36511 |
| 61 | NTIS, PC A02; 3 | DE87011518 | MN -70 | 12:36501 |
| **CONF-870307-** | (ASME/JSME/ISES solar energy conference, Honolulu, HI, USA, 22-27 Mar 1987) | | | |
| 22 | *See* PNL-SA-14022 | DE87011336 | MN -62b | 12:36655 |
| **CONF-870314-** | (Corrosion '87, San Francisco, CA, USA, 9-13 Mar 1987) | | | |
| 11 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011515 | MN -95f | 12:37208 |
| **CONF-870334-** | (Workshop on results and perspectives in particle physics, La Thuile, Italy, 1-7 Mar 1987) | | | |
| 1 | *See* FNAL/C-87/82 | E 1.99: DE87011067 | MN -34D | 12:38126 |
| **CONF-870339-** | (Moriond meeting on hadrons, quarks and gluons, Les Arcs, France, 15-21 Mar 1987) | | | |
| 1 | *See* FNAL/C-87/71 | E 1.99: DE87010082 | MN -34D | 12:38125 |
| **CONF-870366-** | (Alternative energy in the midwest, Rosemont, IL, USA, 18-20 Mar 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011540 | MN -95e | 12:37154 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| **CONF-870388-** | (International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Mar 1987) | | | |
| 10 | *See* PNL-SA-14744 | E 1.99: DE87011145 | MN -25 | 12:37303 |
| 11 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011496 | MN -25 | 12:37209 |
| 12 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011537 | MN -25 | 12:37286 |
| **CONF-870390-** | (22. Recontres de Moriond: electroweak interactions and unified theories conference, Les Arcs, France, 8-15 Mar 1987) | | | |
| 3 | *See* SLAC-PUB-4316 | E 1.99: DE87010312 | MN -34D | 12:38224 |
| 5 | *See* SLAC-PUB-4312 | E 1.99: DE87011591 | MN -34D | 12:38148 |
| 6 | *See* SLAC-PUB-4313 | E 1.99: DE87011592 | MN -34D | 12:38149 |
| **CONF-870396-** | (Lunar and planetary science conference, Houston, TX, USA, 16-20 Mar 1987) | | | |
| 2 | *See* UCRL-96725 | E 1.99: DE87010811 | MN -34B | 12:38070 |
| **CONF-8703127-** | (4. international technical symposium on optical and electro-optical applied science and engineering, Hague, Netherlands, 30 Mar-3 Apr 1987) | | | |
| 1 | *See* UCRL-96629 | DE87009747 | MN -38 | 12:37469 |
| **CONF-8703128-** | (International conference on advances in experimental methods for colliding beam physics, Stanford, CA, USA, 9-13 Mar 1987) | | | |
| 5 | *See* LBL-23452 | E 1.99: DE87011103 | MN -34D | 12:37564 |
| **CONF-8703136-** | (Elementary structure of materials, Les Houches, France, 24 Mar-2 Apr 1987) | | | |
| 3 | *See* DOE/ER/40048-20-N7 | DE87011081 | MN -34D | 12:38269 |
| **CONF-8703140-** | (Field task proposal agreement review meeting, Washington, DC, USA, 24 Mar 1987) | | | |
| 1-Vugraphs | NTIS, PC A02; 3 | DE87008790 | MN -20 | 12:38375 |
| **CONF-8703141-** | (EPA all-investigators meeting, Athens, GA, USA, 23-25 Mar 1987) | | | |
| 1-Summ. | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87008804 | MN -11 | 12:37838 |
| **CONF-8703142-** | (New trends in genetic risk assessment meeting, Nice, France, 9-11 Mar 1987) | | | |
| 1 | *See* UCRL-96644 | E 1.99: DE87010871 | MN -48 | 12:38007 |
| **CONF-8703144-** | (Symposium on complex interactions in lake communities, Notre Dame, IN, USA, 21-26 Mar 1987) | | | |
| 1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87008803 | MN -11 | 12:37833 |
| **CONF-8703148-** | (51. annual meeting of the Midwest Economics Association, St. Louis, MO, USA, 26-28 Mar 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011511 | MN -13 | 12:36993 |
| **CONF-870401-** | (OSA/IEEE conference on lasers and electro-optics (CLEO '87), Baltimore, MD, USA, 27 Apr-1 May 1987) | | | |
| 3-Abst. | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011113 | MN -25 | 12:37474 |
| **CONF-870405-** | (Radiation protection and shielding conference, Knoxville, TN, USA, 22-24 Apr 1987) | | | |
| 4-Vugraphs | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009686 | MN -20d | 12:38369 |
| 10 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87000233 | MN -80 | 12:38291 |
| **CONF-870410-** | (193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987) | | | |
| 25 | *See* PNL-SA-14377 | E 1.99: DE87011148 | MN -4 | 12:36592 |
| 27 | *See* PNL-SA-14315 | E 1.99: DE87011153 | MN -61D | 12:36591 |
| 28 | *See* PNL-SA-14400 | E 1.99: DE87011152 | MN -4 | 12:37406 |
| 31 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011527 | MN -4 | 12:36294 |
| 33 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011526 | MN -95e | 12:37855 |
| **CONF-870413-** | (11. international conference on particles and nuclei, Kyoto, Japan, 20-24 Apr 1987) | | | |
| 1 | *See* BNL-39723 | E 1.99: DE87010448 | MN -34C | 12:38237 |
| **CONF-870418-** | (Topical meeting on anticipated and abnormal transients in nuclear power plants, Atlanta, GA, USA, 12-15 Apr 1987) | | | |
| 4 | *See* BNL-NUREG-39849 | TI87010755 | MN -78 | 12:36811 |
| **CONF-870422-** | (89. annual meeting of the American Ceramic Society, Pittsburgh, PA, USA, 26-30 Apr 1987) | | | |
| 5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011523 | MN -25 | 12:38370 |
| **CONF-870430-** | (International conference on methods and applications of radioanalytical chemistry, Kona, HI, USA, 5-10 Apr 1987) | | | |
| 13 | *See* PNL-SA-14276 | E 1.99: DE87011185 | MN -4 | 12:38045 |
| 15 | *See* PNL-SA-14244 | E 1.99: DE87012025 | MN -4 | 12:37569 |
| **CONF-870438-** | (Spring meeting of the Materials Research Society, Anaheim, CA, USA, 21-25 Apr 1987) | | | |
| 20 | *See* SAND-86-2670C | E 1.99: DE87010779 | MN -25 | 12:37239 |
| 22 | *See* SAND-86-2750C | E 1.99: DE87009060 | MN -25 | 12:37304 |
| 23 | *See* LBL-22476 | E 1.99: DE87011104 | MN -25 | 12:37224 |
| 24 | *See* LBL-23462 | E 1.99: DE87011223 | MN -25 | 12:37340 |
| 25 | *See* LBL-22477 | E 1.99: DE87011028 | MN -25 | 12:37225 |
| 27 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011416 | MN -25 | 12:37287 |
| 28 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011525 | MN -25 | 12:37288 |
| **CONF-870443-** | (2. international conference on the basic and applied chemistry of f-transition and related elements, Lisbon, Portugal, 6-10 Apr 1987) | | | |
| 2 | *See* UCRL-95798 | E 1.99: DE87010878 | MN -4 | 12:36603 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| CONF-870444- | (16. international technical meeting on air pollution modelling and its application, Lindau, F.R. Germany, 6-10 Apr 1987) | | | |
| 2 | *See* PNL-SA-14768 | DE87011146 | MN -11 | 12:37704 |
| CONF-870497- | (NATO workshop on photoinduced charge separation and energy migration in supramolecular species, Capri, Italy, 5-10 Apr 1987) | | | |
| 2 | NTIS, PC A02; 3 | DE87011412 | MN -4 | 12:36622 |
| CONF-870498- | (7. tandem conference, Berlin, F.R. Germany, 6-10 Apr 1987) | | | |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87008799 | MN -28 | 12:37547 |
| 8 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011413 | MN -23 | 12:37370 |
| CONF-8704110- | (5. geothermal program review, Washington, DC, USA, 14-15 Apr 1987) | | | |
| 10 | *See* SAND-87-0922C | DE87011718 | MN -66 | 12:36726 |
| CONF-8704112- | (4. international symposium on accelerator mass spectrometry, Ontario, Canada, 27-30 Apr 1987) | | | |
| 6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010599 | MN -34A | 12:37577 |
| 8 | *See* LA-UR-87-2252 | E 1.99: DE87011330 | MN -70 | 12:36520 |
| CONF-8704123- | (Conference on radon, radium, and other radioactivity in ground water: hydrogeologic impact and application to indoor airborne contamination, Somerset, NJ, USA, 7-9 Apr 1987) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011415 | MN -41 | 12:37848 |
| CONF-8704139- | (ASHRAE education seminar, Dayton, OH, USA, 23 Apr 1987) | | | |
| 1 | *See* MLM-3436(OP) | E 1.99: DE87009196 | MN -95d | 12:37074 |
| CONF-8704140- | (Advanced materials workshop, Livermore, CA, USA, 21-23 Apr 1987) | | | |
| 1 | *See* MLM-3428(OP) | E 1.99: DE87009197 | MN -25 | 12:37341 |
| CONF-8704141- | (IUTAM symposium on advanced boundary element methods, San Antonio, TX, USA, 13-16 Apr 1987) | | | |
| 1 | *See* SAND-87-1114C | E 1.99: DE87010735 | MN -38 | 12:38412 |
| CONF-8704142- | (337. DECHEMA colloquium on environmental problems induced by dumping of fly ash from waste incineration, Frankfurt am Main, F.R. Germany, 2 Apr 1987) | | | |
| Summs. | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752458 | MN -11 | 12:37807 |
| CONF-8704145- | (5. world congress on in vitro fertilization and embryo transfer, Norfolk, VA, USA, 8-9 Apr 1987) | | | |
| 1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010898 | MN -48 | 12:37936 |
| CONF-8704151- | (UCLA symposium: protein structure and design, Los Angeles, CA, USA, 4 Apr 1987) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011116 | MN -4 | 12:37861 |
| CONF-8704154- | (2. research coordination meeting of the performance of solidified high-level waste forms and engineering barriersunder repository conditions, Sydney, Australia, 6-9 Apr 1987) | | | |
| 1 | *See* PNL-SA-14767 | E 1.99: DE87011155 | MN -70 | 12:36530 |
| CONF-8704155- | (Ozone risk communication conference, Amherst, MA, USA, 21-22 Apr 1987) | | | |
| 1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87010887 | MN -11 | 12:37605 |
| CONF-8704157- | (T. A. Read memorial lecture, Urbana, IL, USA, 15 Apr 1987) | | | |
| 1 | *See* LBL-23442 | E 1.99: DE87010976 | MN -25 | 12:37196 |
| CONF-8704158- | (Symposium on waste management, Brussels, Belgium, 28-30 Apr 1987) | | | |
| 1 | *See* PNL-SA-14499 | E 1.99: DE87011186 | MN -70 | 12:36478 |
| CONF-8704163- | (International magnetics conference (INTERMAG), Tokyo, Japan, 14-17 Apr 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011420 | MN -25 | 12:37216 |
| CONF-870501- | (6. ASTM-Euratom symposium on reactor dosimetry, Jackson Hole, WY, USA, 31 May-5 Jun 1987) | | | |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010375 | MN -78 | 12:36777 |
| 4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010372 | MN -80 | 12:36802 |
| 5 | *See* SAND-86-1457C | E 1.99: DE87010033 | MN -80 | 12:36800 |
| 6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011433 | MN -34C | 12:38233 |
| CONF-870510- | (Annual meeting of the American Society of Lubrication Engineers, Anaheim, CA, USA, 11-14 May 1987) | | | |
| 4 | *See* N-87-20421 | | | 12:37344 |
| CONF-870519- | (9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management, London, UK, 12-14 May 1987) | | | |
| 5 | *See* SAND-87-1224C | E 1.99: DE87009502 | MN -78 | 12:36571 |
| CONF-870523- | (9. symposium on biotechnology for fuels and chemicals, Boulder, CO, USA, 5-8 May 1987) | | | |
| 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87009665 | MN -48 | 12:37860 |
| CONF-870529- | (Society of Petroleum Engineers meeting on low permeability reservoirs, Denver, CO, USA, 18-20 May 1987) | | | |
| | Society of Petroleum Engineers, P.O. Box 833836, Richardson, TX 75083 | | | 12:36388 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **CONF-870540-** | (9. international conference on fluidized bed combustion, Boston, MA, USA, 3-7 May 1987) | | | |
| 1 | NTIS, PC A02; 3 | DE87011422 | MN -103 | 12:36351 |
| 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011419 | MN -103 | 12:36352 |
| **CONF-870541-** | (Combustion fundamentals and applications: spring technical meeting of the Central States Section of the Combustion Institute, Argonne, IL, USA, 11-12 May 1987) | | | |
| 1 | *See* UCRL-96437 | E 1.99: DE87008843 | MN -38 | 12:37523 |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011424 | MN -4 | 12:37387 |
| **CONF-870552-** | (5. conference on real-time computer applications in nuclear, particle, and plasma physics, San Francisco, CA, USA, 11-15 May 1987) | | | |
| 15 | *See* FNAL-TM-1463 | DE87010995 | STD -32 | 12:38410 |
| 17 | *See* FNAL-TM-1457 | DE87011001 | STD -32 | 12:38408 |
| 18 | *See* FNAL-TM-1458 | DE87011000 | STD -32 | 12:38409 |
| **CONF-870564-** | (Socioeconomic energy research and analysis conference, Washington, DC, USA, 21-22 May 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011431 | MN -95d | 12:37024 |
| **CONF-870566-** | (Institute of Environmental Sciences annual meeting, San Jose, CA, USA, 4-8 May 1987) | | | |
| 2 | *See* SAND-86-2774C | E 1.99: DE87005849 | MN -38 | 12:37508 |
| **CONF-870570-** | (7. topical conference on applications of radio-frequency power to plasmas, Kissimmee, FL, USA, 4-6 May 1987) | | | |
| 2 | *See* GA-A-18775 | E 1.99: DE87009301 | MN -20a | 12:38337 |
| 9 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009119 | MN -20f | 12:38321 |
| 10 | *See* LBL-23299 | E 1.99: DE87010263 | MN -20 | 12:38342 |
| 12 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010390 | MN -20 | 12:38371 |
| 13 | *See* UCLA/PPG-1070 | E 1.99: DE87010296 | STD -20f | 12:38355 |
| 15 | *See* DOE/ET/51013-218 | DE87011033 | MN -20 | 12:38327 |
| 18 | *See* DOE/ET/51013-221 | E 1.99: DE87011036 | MN -20a | 12:38328 |
| **CONF-870585-** | (6. international heat pipe conference, Grenoble, France, 25-28 May 1987) | | | |
| 2 | *See* LA-UR-87-1000 | DE87007456 | MN -80 | 12:36803 |
| **CONF-870588-** | (20. annual scanning electron microscopy conference, Hamilton, Canada, 3-8 May 1987) | | | |
| 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011455 | MN -4 | 12:38296 |
| **CONF-8705103-** | (Fossil energy materials program conference, Oak Ridge, TN, USA, 19-21 May 1987) | | | |
| 5 | *See* LA-UR-87-1673 | E 1.99: DE87011066 | MN -25 | 12:37300 |
| 6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011432 | MN -25 | 12:37292 |
| 7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011450 | MN -114 | 12:37293 |
| **CONF-8705108-** | (Power industry computer applications conference, Montreal, Canada, 19-23 May 1987) | | | |
| 1 | NTIS, PC A02; 3 | DE87009823 | MN -97 | 12:37511 |
| **CONF-8705113-** | (Institute of Shaft Drilling Technology annual technical conference, Las Vegas, NV, USA, 13-15 May 1987) | | | |
| 1 | NTIS, PC A02; 3 | DE87009332 | MN -38 | 12:37455 |
| **CONF-8705114-** | (35. conference on mass spectrometry and applied topics, Denver, CO, USA, 24-29 May 1987) | | | |
| 2 | *See* SAND-87-0146C | E 1.99: DE87010477 | MN -4 | 12:37380 |
| **CONF-8705116-** | (NATO RSG5 meeting, Portsmouth, UK, 11 May 1987) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009680 | MN -41 | 12:37901 |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009678 | MN -41 | 12:37902 |
| **CONF-8705117-** | (9. international conference on noise in physical systems, Montreal, Canada, 25-29 May 1987) | | | |
| 1 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: DE87010022 | MN -37 | 12:37512 |
| **CONF-8705118-** | (International school of quantum electronics, Erice, Italy, 11-19 May 1987) | | | |
| 1 | *See* UCRL-96579 | E 1.99: DE87010337 | MN -38 | 12:37488 |
| **CONF-8705122-** | (International Energy Agency solar heating and cooling task X expert's meeting, Tokyo, Japan, 11-13 May 1987) | | | |
| 1 | *See* LA-UR-87-1531 | E 1.99: DE87010105 | MN -59A | 12:36684 |
| **CONF-8705124-** | (TEMA-6: 6th international conference on trace elements in man and animals, Asilomar, CA, USA, 31 May-5 Jun 1987) | | | |
| 1 | *See* BNL-39866 | E 1.99: DE87010790 | MN -48 | 12:37937 |
| 2 | *See* BNL-39905 | E 1.99: DE87011304 | MN -48 | 12:37873 |
| **CONF-8705126-** | (Invocating in development conference, New Orleans, LA, USA, 1 May 1987) | | | |
| 1 | *See* SAND-87-0804C | E 1.99: DE87009296 | MN -63 | 12:36648 |
| **CONF-8705128-** | (7. annual symposium of the American Vacuum Society, Oak Ridge, TN, USA, 12-14 May 1987) | | | |
| 1 | *See* RFP-4119 | DE87011056 | MN -4 | 12:37379 |
| **CONF-8705129-** | (Workshop on lattice gauge theory using parallel processors, Beijing, China, 21 May-2 Jun 1987) | | | |
| 1 | *See* BNL-39747 | E 1.99: DE87010045 | MN -34D | 12:38215 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **CONF-8705132-** | (4. annual meeting of the Southeastern Regional Health Physics Society chapters, Williamsburg, VA, USA, 7-9 May 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009120 | MN -41 | 12:37819 |
| **CONF-8705133-** | (1. meeting of the US-EC Fusion Bilateral Coordinating Committee, Brussels, Belgium, 6-7 May 1987) | | | |
| 1-Vugrap'is | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009125 | MN -20a | 12:38376 |
| **CONF-8705143-** | (1. annual conference on protective clothing, Clemson, SC, USA, 29 May 1987) | | | |
| 1 | *See* DP-MS-87-62 | E 1.99: DE87011243 | MN -41 | 12:37457 |
| **CONF-8705144-** | (6. annual working group meeting on symthesis of high energy density materials, Kiamesha Lake, NY, USA, 19-22 May 1987) | | | |
| 1 | *See* LA-UR-87-1739 | E 1.99: DE87010129 | MN -4 | 12:37400 |
| **CONF-8705153-** | (Geological Society of American Cordilleran section meeting, Hilo, HI, USA, 20 May 1987) | | | |
| 1 | *See* PNL-SA-14624 | E 1.99: DE87011995 | MN -70 | 12:36529 |
| **CONF-8705154-** | (21. Pacific Northwest Regional Economic conference, Seattle, WA, USA, 1 May 1987) | | | |
| 1-Summ. | *See* PNL-SA-14605 | E 1.99: DE87011988 | MN -95 | 12:37014 |
| **CONF-8705156-** | (Workshop on magnetic excitations and fluctuations II, Torino, Italy, 23-29 May 1987) | | | |
| 1 | *See* BNL-39924 | E 1.99: DE87012123 | MN -25 | 12:37328 |
| **CONF-870601-** | (Annual meeting of the American Nuclear Society, Dallas, TX, USA, 7-12 Jun 1987) | | | |
| 9 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87005684 | MN -71 | 12:37453 |
| 17 | *See* DP-MS-87-10 | E 1.99: DE87011242 | MN -70 | 12:36512 |
| **CONF-870622-** | (19. fluid dynamics, plasma dynamics, and laser conference, Honolulu, HI, USA, 8-10 Jun 1987) | | | |
| 5 | *See* LA-UR-87-1714 | E 1.99: DE87010126 | MN -38 | 12:37484 |
| 6 | *See* LA-UR-87-1535 | DE87010106 | MN -37 | 12:37483 |
| **CONF-870629-** | (14. European conference on controlled fusion and plasma physics, Madrid, Spain, 22-26 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010402 | MN -20 | 12:38372 |
| 2 | NTIS, PC A02; 3 | DE87010393 | MN -20 | 12:38373 |
| 3 | NTIS, PC A02; 3 | DE87010373 | MN -20 | 12:38374 |
| 4 | *See* GA-A-18842 | E 1.99: DE87010651 | MN -20 | 12:38380 |
| 5 | *See* LA-UR-87-1561 | DE87010110 | MN -20d | 12:38341 |
| 6 | *See* LA-UR-87-1544 | E 1.99: DE87010108 | MN -20f | 12:38340 |
| **CONF-870636-** | (5. national congress on pressure vessels and piping, San Diego, CA, USA, 28 Jun-2 Jul 1987) | | | |
| 12 | *See* HEDL-SA-3629 | E 1.99: DE87009967 | MN -79h | 12:36831 |
| **CONF-870657-** | (Personal computer applications in the gas industry, Chicago, IL, USA, 22-24 Jun 1987) | | | |
| 1 | *See* PNL-SA-14976 | E 1.99: DE87011994 | MN -13 | 12:38016 |
| **CONF-870659-** | (7. annual gasification systems conference, Morgantown, WV, USA, 16-19 Jun 1987) | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011111 | MN -114 | 12:36240 |
| **CONF-870661-** | (11. actinide separations conference, Livermore, CA, USA, 1-4 Jun 1987) | | | |
| 1 | *See* RFP-4105 | DE87011053 | MN -47 | 12:36484 |
| 2 | *See* RFP-4106 | E 1.99: DE87011054 | MN -47 | 12:36490 |
| 3 | *See* RFP-4128 | DE87011049 | MN -47 | 12:36491 |
| 5 | *See* DP-MS-87-9 | E 1.99: DE87011244 | MN -10 | 12:36486 |
| 6 | *See* DP-MS-87-51 | E 1.99: DE87011252 | MN -10 | 12:36513 |
| 7-Vugraphs | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011445 | MN -4 | 12:37437 |
| 8-Summ. | *See* DP-MS-87-55 | E 1.99: DE87011180 | MN -10 | 12:36487 |
| **CONF-870664-** | (25. symposium on engineering aspects of magnetohydrodynamics, Bethesda, MD, USA, 24-26 Jun 1987) | | | |
| 2 | NTIS, PC A02; 3 | DE87011447 | MN -112 | 12:37005 |
| **CONF-870666-** | (11. DOE solar photochemistry research conference, Tahoe City, CA, USA, 7-11 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011442 | MN -61G | 12:36623 |
| **CONF-870668-** | (3. international conference of the Groupe de Travail de Pyrotechnic Spatiale and 12. international pyrotechnics seminar, Paris, France, 8-12 Jun 1987) | | | |
| 5 | *See* MLM-3442(OP) | E 1.99: DE87011840 | MN -45 | 12:37583 |
| **CONF-870677-** | (6. IMACS international symposium on computer methods for partial differential equations, Bethlehem, PA, USA, 23-26 Jun 1987) | | | |
| 7 | *See* UCRL-96763 | DE87010782 | MN -32 | 12:38104 |
| **CONF-870679-** | (5. symposium on energy engineering sciences, Argonne, IL, USA, 17-19 Jun 1987) | | | |
| 1 | *See* SAND-87-1632C | E 1.99: DE87011320 | MN -25 | 12:37517 |
| **CONF-870682-** | (Workshop on novel mechanisms for superconductivity, Berkeley, CA, USA, 22-25 Jun 1987) | | | |
| 1 | *See* SAND-87-1654C | E 1.99: DE87011313 | MN -4 | 12:37408 |
| 2 | *See* LA-UR-87-2119 | E 1.99: DE87011749 | MN -25 | 12:38306 |
| **CONF-8706103-** | (NATO advanced study institute on alloy phase stability, Crete, Greece, 14-27 Jun 1987) | | | |
| 3 | *See* UCRL-96787 | E 1.99: DE87011561 | MN -25 | 12:37245 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| CONF-8706104- | (8. American Institute of Aeronautics and Astronautics computational fluid dynamics conference, Honolulu, HI, USA, 9-11 Jun 1987) | | | |
| 2 | *See* UCRL-96443 | E 1.99: DE87008846 | MN -38 | 12:37502 |
| CONF-8706106- | (JOWOG-12, Aldermaston, UK, 29 Jun-3 Jul 1987) | | | |
| 3 | *See* UCRL-96796 | E 1.99: DE87011879 | MN -4 | 12:37381 |
| CONF-8706113- | (6. Adriatic international conference on nuclear physics, Dubrovnik, Yugoslavia, 15-19 Jun 1987) | | | |
| 2 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010892 | MN -34C | 12:38251 |
| CONF-8706119- | (Workshop on alpha particle effects in ETR, Washington, DC, USA, 15-16 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010605 | MN -20 | 12:38323 |
| CONF-8706123- | (Topical symposium on recent developments in ceramic science, Albuquerque, NM, USA, 17-18 Jun 1987) | | | |
| 1 | *See* SAND-87-1402C | E 1.99: DE87010513 | MN -4 | 12:37407 |
| CONF-8706124- | (Recyclingplas II conference, Washington, DC, USA, 18-19 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010590 | MN -95e | 12:37129 |
| CONF-8706125- | (Conference on advances in cryogenic engineering, St. Charles, IL, USA, 14-18 Jun 1987) | | | |
| 3-Draft | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011684 | MN -25 | 12:37294 |
| CONF-8706126- | (Taiwan Power Company conference, Taipei, Taiwan, 17 Jun 1987) | | | |
| 1-Vugraphs | *See* RFP-4124 | DE87011050 | MN -41 | 12:37933 |
| CONF-8706136- | (AICHE division of health and safety meeting, Houston, TX, USA, 4-9 Jun 1987) | | | |
| 1 | *See* DP-MS-87-37 | E 1.99: DE87011179 | MN -41 | 12:37821 |
| CONF-8706137- | (NATO advanced research workshop on advances in analytical and numerical groundwater flow and quality modeling, Lisbon, Portugal, 2-6 Jun 1987) | | | |
| 1 | *See* LBL-23477 | E 1.99: DE87011224 | MN -11 | 12:38037 |
| CONF-8706142- | (Supercomputing symposium, Calgary, Canada, 15-16 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010894 | MN -34C | 12:38266 |
| CONF-8706151- | (2. international conference on the effects of modes of formation on the structure of glasses, Nashville, TN, USA, 16-18 Jun 1987) | | | |
| 1-Draft | NTIS, PC A02; 3 | DE87011208 | MN -25 | 12:37331 |
| CONF-8706152- | (European Materials Research Society conference, Strasbourg, France, 2-5 Jun 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011642 | MN -25 | 12:37332 |
| CONF-870711- | (Solar '87: 12th national passive solar conference, Portland, OR, USA, 12-16 Jul 1987) | | | |
| 5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011391 | MN -59B | 12:36701 |
| CONF-870713- | (28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987) | | | |
| 1 | *See* Y/DS-254 | E 1.99: DE87005738 | MN -2 | 12:36573 |
| 3 | *See* BNL-39822 | E 1.99: DE87010763 | MN -15 | 12:36557 |
| 9 | *See* DP-MS-86-8 | E 1.99: DE87011253 | MN -16 | 12:36559 |
| 10 | *See* LA-UR-87-2117 | DE87011751 | MN -15 | 12:36562 |
| 11 | *See* SAND-87-1038C | DE87011866 | MN -15 | 12:36569 |
| 12 | *See* SAND-87-1022C | DE87011867 | MN -15 | 12:36568 |
| 13 | *See* SAND-86-2986C | DE87011859 | MN -15 | 12:36564 |
| 14 | *See* SAND-87-0947C | DE87011858 | MN -15 | 12:36566 |
| 15 | *See* SAND-87-0977C | E 1.99: DE87011855 | MN -15 | 12:36567 |
| 16 | *See* LA-UR-87-1952 | E 1.99: DE87011783 | MN -15 | 12:36560 |
| 17 | *See* LA-UR-87-2116 | DE87011752 | MN -15 | 12:36561 |
| 27 | *See* SAND-87-1702C | E 1.99: DE87012363 | MN -71 | 12:37465 |
| CONF-870724- | (24. annual conference on nuclear and space radiation in electronics, Snowmass, CO, USA, 28-31 Jul 1987) | | | |
| 12 | *See* SAND-87-0403C | E 1.99: DE87006129 | MN -34C | 12:37516 |
| CONF-870725- | (22. annual meeting of the Microbeam Analysis Society, Kailua-Kona, HI, USA, 13-17 Jul 1987) | | | |
| 8 | *See* LBL-23259 | DE87011090 | MN -32 | 12:38411 |
| CONF-870734- | (American Association for Artificial Intelligence meeting, Seattle, WA, USA, 13-17 Jul 1987) | | | |
| 1 | *See* SAND-87-0273C | DE87005875 | MN -38 | 12:37463 |
| CONF-870743- | (Carnahan conference on security technology, Atlanta, GA, USA, 15-17 Jul 1987) | | | |
| 5 | *See* UCRL-96407 | DE87011558 | MN -15 | 12:36572 |
| CONF-870752- | (11. international symposium on molecular beams, Edinburgh, UK, 12-17 Jul 1987) | | | |
| 1-Ext.Abst. | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009812 | MN -34A | 12:38094 |
| CONF-870753- | (5. topical conference of the American Physical Society on shockwaves in condensed matter, Monterey, CA, USA, 20-23 Jul 1987) | | | |
| 1 | *See* UCRL-96021 | E 1.99: DE87009745 | MN -38 | 12:37468 |
| 2 | *See* SAND-87-0765C | E 1.99: DE87011064 | MN -34 | 12:38301 |
| 8 | *See* LA-UR-87-2134 | E 1.99: DE87011743 | MN -25 | 12:37221 |
| 11 | *See* SAND-87-0622C | E 1.99: DE87011059 | MN -25 | 12:37241 |
| 12 | *See* LA-UR-87-1964 | DE87011781 | MN -45 | 12:37582 |
| 14 | *See* LA-UR-87-2198 | E 1.99: DE87011733 | MN -25 | 12:37223 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| **CONF-870755-** | (14. transducer workshop, Colorado Springs, CO, USA, 16-18 Jul 1987) | | | | |
| 1 | *See* SAND-86-1606C | | DE87009295 | MN -38 | 12:37579 |
| **CONF-870756-** | (Symposium on aging and maintenance, Vienna, Austria, 3 Jul 1987) | | | | |
| 1 | *See* SAND-87-1091C | E 1.99: | DE87010496 | MN -80 | 12:36806 |
| 2 | *See* SAND-86-2869C | E 1.99: | DE87010494 | MN -80 | 12:36929 |
| **CONF-870757-** | (IEEE Power Engineering Society summer meeting, San Francisco, CA, USA, 12-17 Jul 1987) | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010401 | MN -97a | 12:36767 |
| 2 | NTIS, PC A02; 3 | | DE87010394 | MN -97 | 12:36768 |
| **CONF-870759-** | (5. international swarm seminar, Birmingham, UK, 29-31 Jul 1987) | | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010889 | MN -4 | 12:37388 |
| **CONF-870761-** | (3. international conference on modulated semiconductor structure, Montpelier, France, 6-10 Jul 1987) | | | | |
| 1 | *See* SAND-87-0404C | E 1.99: | DE87010739 | MN -25 | 12:37349 |
| **CONF-870763-** | (3. annual solid waste testing and quality assurance symposium, Washington, DC, USA, 14-17 Jul 1987) | | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | A 1.99: | DE87010906 | MN -70 | 12:37371 |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011932 | MN -4 | 12:37372 |
| **CONF-870764-** | (Seminar on microbial processing of coal in studiengesellschaft Kohlegewinnung Zweite generation, Essen, F.R. Germany, 9-10 Jul 1987) | | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011114 | MN -108 | 12:36295 |
| **CONF-870768-** | (Mid-central ergonomics/human factors conference, Champaign, IL, USA, 15-17 Jul 1987) | | | | |
| 1 | *See* DP-MS-87-49 | E 1.99: | DE87011183 | MN -16 | 12:36825 |
| **CONF-870769-** | (APS topical conference on shock waves in condensed matter, Monterey, Canada, 20-23 Jul 1987) | | | | |
| 1 | *See* SAND-87-0741C | E 1.99: | DE87011637 | MN -25 | 12:37242 |
| **CONF-870772-** | (2. international conference on advances in numerical methods in engineering: theory and application, Swansea, UK, 6-10 Jul 1987) | | | | |
| 1 | *See* UCRL-96643 | E 1.99: | DE87011562 | MN -25 | 12:37244 |
| **CONF-870801-** | (International conference on nuclear fuel reprocessing and waste management, Paris, France, 24-28 Aug 1987) | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010601 | MN -70A | 12:36502 |
| **CONF-870802-** | (194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug-4 Sep 1987) | | | | |
| 2 | *See* SAND-87-0683C | E 1.99: | DE87008509 | MN -4 | 12:36600 |
| 3 | *See* SAND-87-0682C | E 1.99: | DE87008510 | MN -4 | 12:36593 |
| 5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008805 | MN -102 | 12:36296 |
| 6 | *See* LBL-23352 | E 1.99: | DE87010279 | MN -105 | 12:36330 |
| 7 | *See* LBL-23312 | E 1.99: | DE87010740 | MN -105 | 12:36329 |
| 8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011396 | MN -4 | 12:37389 |
| 9 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011667 | MN -113 | 12:36297 |
| **CONF-870804-** | (22. intersociety energy conversion engineering conference, Philadelphia, PA, USA, 10-14 Aug 1987) | | | | |
| 1 | *See* SAND-86-2828C | E 1.99: | DE87009289 | MN -59A | 12:36658 |
| 2 | *See* SAND-87-7115C | E 1.99: | DE87009503 | MN -94cb | 12:36946 |
| 5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009681 | MN -94 | 12:36786 |
| 6 | *See* SAND-87-1306C | E 1.99: | DE87010034 | MN -93 | 12:37008 |
| 8 | *See* SAND-86-2823C | | DE87010435 | MN -62c | 12:36657 |
| 10 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010597 | MN -95d | 12:37025 |
| 12 | *See* DOE/NASA/17088-5 | | DE87011605 | STD -11 | 12:37012 |
| 13 | NTIS, PC A02; 3 | | DE87011402 | MN -94cb | 12:36941 |
| 14 | NTIS, PC A02; 3 | | DE87011388 | MN -94cb | 12:36942 |
| 16 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011383 | MN -110 | 12:37010 |
| 17 | NTIS, PC A02; 3 | | DE87011385 | MN -93 | 12:37527 |
| 18 | NTIS, PC A02; 3 | | DE87011386 | MN -23 | 12:36574 |
| **CONF-870811-** | (Energy conservation program evaluation: practical methods and useful results, Chicago, IL, USA, 19-21 Aug 1987) | | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010888 | MN -95d | 12:37026 |
| **CONF-870812-** | (9. SMIRT: international conference on structural mechanics in reactor technology, Lausanne, Switzerland, 17-21 Aug 1987) | | | | |
| 12 | *See* HEDL-SA-3673-FP | E 1.99: | DE87009968 | MN -25 | 12:37505 |
| 20 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011469 | MN -70 | 12:36503 |
| **CONF-870815-** | (6. International Society for Rock Mechanics congress, Montreal, Canada, 30 Aug-4 Sep 1987) | | | | |
| 2 | *See* LBL-22718 | | DE87006147 | MN -70 | 12:38043 |
| 3 | *See* LBL-22747 | | DE87006944 | MN -11 | 12:38044 |
| **CONF-870816-** | (Thermal hydraulics of severe nuclear reactor accidents/national heat transfer conference joint conference, Pittsburgh, PA, USA, 9-12 Aug 1987) | | | | |
| 8 | *See* SAND-87-0094C | E 1.99: | DE87005870 | MN -71 | 12:37462 |
| 12 | *See* SAND-86-2447C | E 1.99: | DE87006657 | MN -71 | 12:37460 |
| 22 | NTIS, PC A02; 3 | | DE87011397 | MN -4 | 12:37390 |
| **CONF-870833-** | (Crypto '87, Santa Barbara, CA, USA, 16-20 Aug 1987) | | | | |
| 1 | *See* SAND-87-0180C | E 1.99: | DE87005536 | MN -13 | 12:36565 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 2 | *See* SAND-87-0800C | E 1.99: DE87011861 | MN -13 | 12:38399 |
| **CONF-870853-** | (INDOOR AIR '87: 4th international conference on indoor air quality and climate, Berlin, F.R. Germany, 17-21 Aug 1987) | | | |
| 1 | *See* BNL-39456 | E 1.99: DE87008198 | MN -11 | 12:37709 |
| 2 | *See* BNL-39457 | E 1.99: DE87008203 | MN -11 | 12:37600 |
| 4 | *See* LBL-23136 | E 1.99: DE87009164 | MN -11 | 12:37712 |
| **CONF-870862-** | (45. annual meeting of the Electron Microscopy Society of America, Baltimore, MD, USA, 2-7 Aug 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009133 | MN -25 | 12:37289 |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87003456 | MN -25 | 12:37210 |
| 5 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87008797 | MN -25 | 12:37211 |
| 6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009132 | MN -25 | 12:37290 |
| **CONF-870864-** | (4. American Meteorological Society's conference on mountain meteorology, Seattle, WA, USA, 25-28 Aug 1987) | | | |
| 7 | *See* UCRL-96243 | DE87010813 | MN -34B | 12:37728 |
| **CONF-870867-** | (2. international symposium on rock fragmentation by blasting, Keystone, CO, USA, 23-28 Aug 1987) | | | |
| 1 | *See* SAND-86-2884C | DE87009501 | MN -123 | 12:36467 |
| 3 | *See* SAND-86-2883C | DE87009499 | MN -123 | 12:36466 |
| 4 | *See* UCRL-96585 | A 1.99: DE87010247 | MN -11 | 12:38048 |
| **CONF-870873-** | (18. conference on low temperature physics, Kyoto, Japan, 20-26 Aug 1987) | | | |
| 2 | NTIS, PC A02; 3 | DE87009822 | MN -34 | 12:37212 |
| 3 | NTIS, PC A02; 3 | DE87009825 | MN -25 | 12:37291 |
| 5 | *See* LBL-23530 | E 1.99: DE87011100 | MN -25 | 12:37226 |
| 6 | *See* LBL-23532 | E 1.99: DE87011096 | MN -25 | 12:37227 |
| 7 | *See* LBL-23533 | E 1.99: DE87011097 | MN -4 | 12:37228 |
| **CONF-870877-** | (9. power system computation conference, Lisbon, Portugal, 30 Aug-4 Sep 1987) | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009818 | MN -97 | 12:36769 |
| **CONF-870887-** | (6. medical chemical defense bioscience review, Baltimore, MD, USA, 1 Aug 1987) | | | |
| 1 | *See* LA-UR-87-1748 | E 1.99: DE87010131 | MN -48 | 12:37959 |
| **CONF-870890-** | (3. annual Armed Forces Communications Electronics Association and exposition, Philadelphia, PA, USA, 4-5 Aug 1987) | | | |
| 1 | *See* SAND-87-0283C | E 1.99: DE87010738 | MN -15 | 12:37596 |
| 2 | *See* SAND-87-1128C | E 1.99: DE87009290 | MN -15 | 12:36570 |
| 3 | *See* LA-UR-87-2107 | E 1.99: DE87011755 | MN -13 | 12:38396 |
| **CONF-870892-** | (Symposium on the foundations of modern physics, Joensuu, Finland, 6-8 Aug 1987) | | | |
| 1 | *See* SLAC-PUB-4257 | E 1.99: DE87010463 | MN -34D | 12:38309 |
| **CONF-870893-** | (6. international conference on rapidly quenched metals, Montreal, Canada, 3-7 Aug 1987) | | | |
| 1 | *See* SAND-87-0071C | E 1.99: DE87010741 | MN -25 | 12:37240 |
| 2 | *See* LA-UR-87-2160 | DE87011737 | MN -25 | 12:37222 |
| **CONF-870895-** | (Major hazards in the transport and storage of pressure liquefied gases conference, Fredericton, Canada, 10-13 Aug 1987) | | | |
| 1 | *See* SAND-87-0641C | E 1.99: DE87011317 | MN -71 | 12:37464 |
| **CONF-870988-** | (16. annual conference of the North American Thermal Analysis Society, Washington, DC, USA, 27-30 Sep 1987) | | | |
| 2 | *See* SAND-87-0636C | E 1.99: DE87010431 | MN -25 | 12:37351 |
| **CONF-8709106-** | (Conference on safety in handling glass, Annecy, France, 16 Sep 1987) | | | |
| 1 | *See* UCRL-95561 | E 1.99: DE87009850 | MN -41 | 12:38017 |
| **COO-** | | | | |
| 2271-110 | *See* DOE/ER/02271-110 | E 1.99: DE87010235 | MN -34D | 12:38157 |
| 2570-11 | *See* DOE/ER/02570-11 | E 1.99: DE87012074 | MN -4 | 12:36624 |
| 3130TA-630 | *See* DOE/ER/03130-630 | E 1.99: DE87012064 | MN -34D | 12:38158 |
| 3130TB-262 | *See* DOE/ER/03130-262 | E 1.99: DE87011621 | MN -34D | 12:38119 |
| 3130TB-264 | *See* DOE/ER/03130-264 | E 1.99: DE87012065 | MN -34D | 12:38120 |
| 3130TC-35 | *See* DOE/ER/03130-35 | E 1.99: DE87012066 | MN -34D | 12:38118 |
| **CRC-** | | | | |
| 552 | *See* AD-A-179685/3/XAB | | | 12:36411 |
| **CSE-** | | | | |
| 86-120 | *See* AD-A-179258/9/XAB | | | 12:38085 |
| 86-139 | *See* AD-A-179539/2/XAB | | | 12:38041 |
| **CSI-** | | | | |
| 84-105 | *See* PB-87-173613/XAB | | | 12:37485 |
| **CU-CSD-** | | | | |
| 87-823 | *See* AD-A-179359/5/XAB | | | 12:38417 |
| **DESY-** | | | | |
| 86-012 | NTIS PC E07; Available from NTIS as TIB/B87-06444 | | ND -34D | 12:38116 |
| 86-023 | NTIS PC E07; Available from NTIS as TIB/B87-06441 | | ND -34D | 12:38117 |
| 86-156 | NTIS PC E07; Available from NTIS as TIB/B87-07042 | | ND -34D | 12:38156 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **DESY-L-Trans-** | | | | |
| 315 | NTIS PC E07; Available from NTIS as TIB/B87-04530 | | ND -34D | 12:38208 |
| 317 | NTIS PC E07; Available from NTIS as TIB/B87-07040 | | ND -34D | 12:38206 |
| 318 | NTIS PC E07; Available from NTIS as TIB/B87-07041 | | ND -34C | 12:38255 |
| **DESY-SR-** | | | | |
| 86-10 | NTIS PC E07; Available from NTIS as TIB/B87-04641 | | ND -41 | 12:37875 |
| **DFVLR-FB-** | | | | |
| 87-04 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87770175 | MN -38 | 12:37525 |
| **DHEW/PUB/NIOSH-** | | | | |
| 86-122 | *See* PB-87-173209/XAB | | | 12:37888 |
| **DOE/BC-** | | | | |
| 86/ 6/ SP | NTIS, PC A25/MF A01; 1 (GPO Dep.) | E 1.99: DE87001219 | STD -122 | 12:36376 |
| 87/ 2/ SP | NTIS, PC A13/MF A01; 1 (GPO Dep.) | E 1.99: DE87001217 | STD -122 | 12:36377 |
| **DOE/BC/10841-** | | | | |
| 5 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87001250 | STD -122 | 12:36378 |
| **DOE/BC/10846-** | | | | |
| 5 | NTIS, PC A14/MF A01; 1 (GPO Dep.) | E 1.99: DE87001245 | STD -122 | 12:36379 |
| **DOE/BC/10847-** | | | | |
| 5 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87001244 | STD -122 | 12:36380 |
| **DOE/BP-** | | | | |
| 707 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010345 | MN -97 | 12:36994 |
| 847 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87011911 | MN -11 | 12:37834 |
| 63585-1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011910 | MN -95d | 12:37027 |
| **DOE/BP/18945-** | | | | |
| T7 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011166 | MN -95f | 12:37130 |
| **DOE/CE/24444-** | | | | |
| T1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010657 | MN -95d | 12:37028 |
| **DOE/CE/26526-** | | | | |
| T1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87009076 | MN -95d | 12:37155 |
| **DOE/CE/40539-** | | | | |
| 02 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87009319 | MN -95f | 12:37131 |
| 04 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | E 1.99: DE87009321 | MN -95f | 12:37132 |
| 05 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87009322 | MN -95f | 12:37133 |
| 06 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87009323 | MN -95f | 12:37134 |
| **DOE/CE/40736-** | | | | |
| T1 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: DE87011274 | MN -95f | 12:37135 |
| **DOE/CE/63492-** | | | | |
| T3 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: DE87012139 | MN -95 | 12:38391 |
| **DOE/CE/63498-** | | | | |
| T1 | NTIS, PC A03; 3 | DE87010785 | MN -95 | 12:38392 |
| **DOE/CE/63503-** | | | | |
| T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87007148 | MN -95d | 12:37061 |
| T2 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87007149 | MN -95d | 12:37062 |
| T3-Pt.1 | NTIS, PC A05; 3 | DE87007150 | MN -95d | 12:37063 |
| T3-Pt.2 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87007151 | MN -95d | 12:37064 |
| T3-Pt.3 | NTIS, PC A08; 3 | DE87007152 | MN -95d | 12:37065 |
| **DOE/CE/90001-** | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011335 | MN -25 | 12:37295 |
| **DOE/CH-** | | | | |
| 15-1 | NTIS, PC A99/MF A01; 1 (GPO Dep.) | E 1.99: DE87012337 | MN -70 | 12:36504 |
| 15-2 | NTIS, PC A19 IF A01; 1 (GPO Dep.) | E 1.99: DE87012336 | MN -70 | 12:36505 |
| **DOE/CH/10235-** | | | | |
| 2 | NTIS, PC A02; 3 | DE87011202 | MN -4 | 12:37391 |
| **DOE/CS/50058-** | | | | |
| T1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87004908 | MN -96 | 12:37161 |
| **DOE/DP-** | | | | |
| 0043 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87011615 | MN -2 | 12:36558 |
| 0044 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011693 | MN -70 | 12:36506 |
| **DOE/EA-** | | | | |
| 0254 | NTIS, PC A25/MF A01; 1 | DE87011700 | MN -70A | 12:36547 |
| 0322 | NTIS, PC A15/MF A01; 1 (GPO Dep.) | E 1.99: DE87011997 | MN -70A | 12:36552 |
| **DOE/EIA-** | | | | |
| 0035(87/ 03) | NTIS, PC A07/MF A01 - GPO (GPO Dep.) | E 1.99: DE87011892 | MN -98F | 12:36977 |
| 0380(87/ 04) | NTIS, PC A08 - GPO; 3 | DE87012182 | MN -98B | 12:36417 |
| 0482 | NTIS, PC A12/MF A01 - GPO; 1 (GPO Dep.) | E 1.99: DE87011891 | MN -98 | 12:37002 |
| 0501 | NTIS, PC A05/MF A01 - GPO; 1 (GPO Dep.) | E 1.99: DE87012180 | MN -98B | 12:36381 |
| M021 | NTIS, PC A09/MF A01 - GPO; 1 (GPO Dep.) | E 1.99: DE87011188 | MN -98 | 12:36984 |
| M023 | NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.) | E 1.99: DE87011712 | MN -98F | 12:36949 |
| **DOE/EIS-** | | | | |
| 0132-D-Vol.1 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: DE87010643 | MN -70A | 12:36548 |
| **DOE/ER-** | | | | |
| 0146/ 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87005570 | STD -13 | 12:38393 |
| **DOE/ER/02271-** | | | | |
| 110 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010235 | MN -34D | 12:38157 |
| **DOE/ER/02570-** | | | | |
| 11 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012074 | MN -4 | 12:36624 |
| **DOE/ER/03130-** | | | | |
| 35 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87012066 | MN -34D | 12:38118 |
| 262 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: DE87011621 | MN -34D | 12:38119 |
| 264 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87012065 | MN -34D | 12:38120 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| 630 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87012064 | MN -34D | 12:38158 |
| T13 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011869 | MN -34D | 12:38159 |
| **DOE/ER/03416-** | | | | | |
| 48 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011926 | MN -4 | 12:37432 |
| **DOE/ER/03591-** | | | | | |
| 1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012099 | MN -34C | 12:38238 |
| **DOE/ER/04073-** | | | | | |
| 20 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011190 | MN -4 | 12:37373 |
| **DOE/ER/04987-** | | | | | |
| 8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012204 | MN -4 | 12:37392 |
| **DOE/ER/05096-** | | | | | |
| 26 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011207 | MN -34D | 12:38121 |
| **DOE/ER/05126-** | | | | | |
| 307 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87007376 | MN -34C | 12:38267 |
| **DOE/ER/06042-** | | | | | |
| 7 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011087 | MN -4 | 12:37333 |
| **DOE/ER/10604-** | | | | | |
| 7 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87011979 | MN -4 | 12:37374 |
| **DOE/ER/10638-** | | | | | |
| 7 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010304 | MN -34C | 12:38229 |
| **DOE/ER/10699-** | | | | | |
| T6 | NTIS, PC A04; 3 | | DE87011868 | MN -34D | 12:38122 |
| **DOE/ER/10807-** | | | | | |
| 03 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011018 | MN -34 | 12:38101 |
| **DOE/ER/12087-** | | | | | |
| T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012299 | MN -48 | 12:36625 |
| **DOE/ER/13108-** | | | | | |
| T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012198 | MN -4 | 12:37434 |
| **DOE/ER/13163-** | | | | | |
| 14 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011341 | MN -25 | 12:37296 |
| **DOE/ER/13295-** | | | | | |
| T1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011661 | MN -4 | 12:37393 |
| **DOE/ER/13327-** | | | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011197 | MN -4 | 12:37394 |
| **DOE/ER/13449-** | | | | | |
| T8 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010969 | MN -21 | 12:38324 |
| **DOE/ER/13465-** | | | | | |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009802 | MN -4 | 12:37435 |
| **DOE/ER/13532-** | | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011076 | MN -48 | 12:36626 |
| **DOE/ER/13546-** | | | | | |
| 1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010748 | MN -48 | 12:37862 |
| **DOE/ER/25014-** | | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011015 | MN -32 | 12:38102 |
| **DOE/ER/40048-** | | | | | |
| 19-N7 | NTIS, PC A02; 3 | | DE87011082 | MN -34C | 12:38268 |
| 20-N7 | NTIS, PC A02; 3 | | DE87011081 | MN -34D | 12:38269 |
| 192 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009711 | MN -34C | 12:38244 |
| **DOE/ER/40068-** | | | | | |
| 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010248 | MN -34C | 12:38270 |
| **DOE/ER/40073-** | | | | | |
| T2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011217 | MN -34D | 12:38160 |
| **DOE/ER/40107-** | | | | | |
| T3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010794 | MN -34D | 12:38123 |
| **DOE/ER/40150-** | | | | | |
| 1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008676 | MN -28 | 12:37529 |
| 2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008679 | MN -34C | 12:38234 |
| 7 | NTIS, PC A02; 3 | | DE87008678 | MN -28 | 12:37541 |
| 8 | NTIS, PC A02; 3 | | DE87008674 | MN -28 | 12:37530 |
| 9 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008677 | MN -34C | 12:38235 |
| 10 | NTIS, PC A02; 3 | | DE87008659 | MN -28 | 12:37548 |
| 12 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008662 | MN -34D | 12:38161 |
| 13 | NTIS, PC A02; 3 | | DE87008671 | MN -28 | 12:37549 |
| 15 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008672 | MN -34C | 12:38230 |
| 22 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: | DE87008491 | MN -34C | 12:38271 |
| 23 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008675 | MN -34C | 12:38272 |
| 24 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: | DE87008666 | MN -28 | 12:37531 |
| 25 | NTIS, PC A02; 3 | | DE87008667 | MN -34D | 12:38124 |
| 27 | NTIS, PC A02; 3 | | DE87008673 | MN -28 | 12:37542 |
| 29 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: | DE87008664 | MN -28 | 12:37532 |
| **DOE/ER/40158-** | | | | | |
| 3 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010682 | MN -34D | 12:38162 |
| **DOE/ER/40200-** | | | | | |
| 091 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010914 | MN -34D | 12:38163 |
| 092 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010915 | MN -34D | 12:38164 |
| **DOE/ER/40272-** | | | | | |
| 32 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | A 1.99: | DE87008766 | MN -34B | 12:38057 |
| 37 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011205 | MN -34D | 12:38216 |
| 38 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011206 | MN -34D | 12:38217 |
| **DOE/ER/40278-** | | | | | |
| 1 | World Sci. Publ. Co., Box 128, Farrer R.I., Singapore 9138 | | TI87010800 | ND -34D | 12:38207 |
| **DOE/ER/45077-** | | | | | |
| 3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012147 | MN -25 | 12:37334 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| DOE/ER/45135-17 | NTIS, PC A02/MF A01; 1 | | DE87009448 | MN -34 | 12:38297 |
| DOE/ER/45160-1 | NTIS, PC A02; 3 | | DE87012077 | MN -34C | 12:38292 |
| DOE/ER/45163-10 | NTIS, PC A02; 3 | | DE87011829 | MN -25 | 12:37335 |
| DOE/ER/45280-1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011709 | MN -25 | 12:37217 |
| DOE/ER/52118-2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010960 | MN -20 | 12:38377 |
| DOE/ER/52127-12 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011044 | MN -21 | 12:38325 |
| DOE/ER/60381-2 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011837 | MN -48 | 12:36627 |
| DOE/ER/75173-1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010406 | MN -80 | 12:36819 |
| DOE/ET/33075-T1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011199 | MN -4 | 12:37395 |
| DOE/ET/51013-206 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010005 | MN -20f | 12:38326 |
| 218 | NTIS, PC A02; 3 | | DE87011033 | MN -20 | 12:38327 |
| 221 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011036 | MN -20a | 12:38328 |
| DOE/ET/53088-213 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010764 | MN -20g | 12:38329 |
| 254 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010765 | MN -20g | 12:38330 |
| 275 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010788 | MN -20g | 12:38331 |
| 276 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010766 | MN -20f | 12:38332 |
| 277 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010767 | MN -20g | 12:38333 |
| 279 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010768 | MN -20g | 12:38334 |
| DOE/EV/05854-9 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012153 | MN -48 | 12:37863 |
| DOE/FC/10627-2363 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012183 | MN -106 | 12:36353 |
| DOE/FE-0083 | H; 1 (GPO Dep.) | E 1.99: | DE87010690 | STD -101 | 12:36235 |
| 0084-1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011945 | MN -126 | 12:36427 |
| 0087 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010815 | MN -101 | 12:36326 |
| DOE/FE/60177-2365 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011848 | STD -123 | 12:36468 |
| 2366 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012040 | STD -123 | 12:36473 |
| 2367 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012039 | STD -123 | 12:36474 |
| 2368 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012041 | STD -123 | 12:36475 |
| 2375 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012681 | STD -123 | 12:36469 |
| DOE/HWP-25 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011968 | STD -69 | 12:36959 |
| DOE/ID-10150 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011703 | STD -95f | 12:37136 |
| 10171 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012038 | STD -95f | 12:37137 |
| DOE/ID/12170-2 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012055 | STD -95f | 12:37138 |
| DOE/ID/12524-T2 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011630 | MN -66a | 12:36721 |
| DOE/ID/12560-4 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012421 | STD -95f | 12:37139 |
| DOE/ID/12583-2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011039 | MN -95f | 12:37140 |
| DOE/ID/12584-5 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011230 | STD -70A | 12:37820 |
| DOE/JPL/956985-1 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009559 | MN -63b | 12:37336 |
| DOE/LC/11067-2235-Vol.2 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87001040 | STD -123 | 12:36477 |
| DOE/MA-0271 | H; 1 (GPO Dep.) | E 1.99: | DE87012203 | MN -13 | 12:38394 |
| 0297-1 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: | DE87012000 | MN -05 | 12:36971 |
| DOE/MC/19210-2357 | NTIS, PC A13/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010863 | STD -109 | 12:36299 |
| DOE/MC/19403-1816 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: | DE86001589 | STD -110 | 12:37011 |
| DOE/MC/21097-2338 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: | DE87006477 | STD -109 | 12:36241 |
| DOE/MC/21131-2350 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87006489 | STD -132 | 12:36430 |
| DOE/MC/23249-2360 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012048 | MN -103 | 12:36354 |
| DOE/NASA/17088-5 | NTIS, PC A02; 3 | | DE87011605 | STD -11 | 12:37012 |
| DOE/NBM-7010972 | NTIS, PC A24/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010972 | MN -2 | 12:37593 |
| DOE/NE/32117-H1 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010618 | MN -2 | 12:36787 |
| DOE/NE/37959-2 | NTIS, PC A02; 3 | | DE87010679 | MN -80 | 12:36812 |
| 3 | NTIS, PC A02; 3 | | DE87010680 | MN -80 | 12:36813 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| DOE/NE/44139-20 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87011799 | STD -70 | 12:36553 |
| 27 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87011800 | STD -70 | 12:36507 |
| 33 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011872 | STD -70 | 12:36508 |
| DOE/OR/21495-T1 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87009956 | MN -70 | 12:36492 |
| DOE/PC/60015-44 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87012098 | MN -108 | 12:36310 |
| DOE/PC/60038-T6 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87011691 | MN -108 | 12:36260 |
| DOE/PC/62700-T10 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87012201 | MN -102 | 12:36364 |
| DOE/PC/70753-T11 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011047 | MN -102 | 12:36265 |
| DOE/PC/70765-9 | NTIS, PC A18/MF A01; 1 (GPO Dep.) | E 1.99: DE87007689 | MN -102 | 12:36360 |
| DOE/PC/70777-T2 | NTIS, PC A05; 3 | DE87011198 | MN -102 | 12:37396 |
| DOE/PC/70780-T7 | NTIS, PC A02; 3 | DE87011626 | MN -108 | 12:36597 |
| DOE/PC/70786-T9 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011268 | MN -108 | 12:36266 |
| DOE/PC/70809-T14 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011831 | MN -102 | 12:36311 |
| DOE/PC/70812-11 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011263 | MN -108 | 12:36267 |
| DOE/PC/73226-4 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87008308 | MN -105 | 12:37606 |
| DOE/PC/80011-T1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87012079 | MN -108 | 12:36582 |
| DOE/PC/80016-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010705 | MN -108 | 12:36583 |
| T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012047 | MN -108 | 12:36584 |
| DOE/PC/80518-T7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010708 | MN -102 | 12:36268 |
| DOE/PC/80525-T7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011084 | MN -105 | 12:36269 |
| DOE/PC/80537-T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010858 | MN -102 | 12:36312 |
| T5 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010855 | MN -102 | 12:36313 |
| T6 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010856 | MN -102 | 12:36314 |
| DOE/PC/80908-4 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87012091 | MN -102 | 12:36270 |
| DOE/PC/80913-7 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | A 1.99: DE87011342 | MN -113 | 12:36315 |
| DOE/PC/81210-T15 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012096 | MN -102 | 12:36236 |
| DOE/PC/90275-T4 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009064 | MN -90e | 12:36361 |
| DOE/PC/90502-3 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011981 | MN -102 | 12:36316 |
| DOE/PC/90504-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011340 | MN -102 | 12:36317 |
| DOE/PC/90507-T3 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87012087 | MN -102 | 12:36318 |
| DOE/PC/90514-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011218 | MN -113 | 12:36327 |
| DOE/PC/90519-T2 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010704 | MN -102 | 12:36319 |
| DOE/PC/90529-2 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011683 | MN -102 | 12:36271 |
| DOE/PC/90536-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012108 | MN -102 | 12:36237 |
| DOE/PC/90538-3 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010774 | MN -102 | 12:36238 |
| DOE/PC/90909-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010752 | MN -108 | 12:36272 |
| DOE/PC/90961-T3 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011264 | MN -115 | 12:37493 |
| DOE/PC/91272-T11 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87010424 | MN -102 | 12:36239 |
| DOE/RA/23209-1 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010943 | STD -97e | 12:36615 |
| DOE/S-0058 | NTIS, PC A04/MF A01 (GPO Dep.) | E 1.99: DE87008149 | MN -34 | 12:36972 |
| DOE/SF/00098-T12 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011602 | MN -95d | 12:37066 |
| DOE/SF/11564-22 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: DE87001247 | STD -122 | 12:36382 |
| 23 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87001248 | STD -122 | 12:36383 |
| 24 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87001249 | STD -122 | 12:36384 |
| DOE/SF/11653-T12 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: DE87009866 | MN -66a | 12:36725 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| **DOE/SF/15303-** | | | | | |
| 1 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010502 | MN -59A | 12:36681 |
| 2 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010501 | MN -59A | 12:36682 |
| **DOE/SF/15774-** | | | | | |
| T2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011265 | MN -95d | 12:37067 |
| **DOE/SF/15799-** | | | | | |
| T12 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011682 | MN -66a | 12:36731 |
| **DOE/SR/00870-** | | | | | |
| 40 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012148 | MN -48 | 12:37765 |
| **DP-MS-** | | | | | |
| 86-8 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011253 | MN -16 | 12:36559 |
| 86-138 | NTIS, PC A02; 3 | | DE87011219 | MN -70B | 12:36510 |
| 86-149 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87006390 | MN -48 | 12:37808 |
| 86-151 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010164 | MN -25 | 12:37218 |
| 86-155 | NTIS, PC A02; 3 | | DE87011175 | MN -11 | 12:37825 |
| 86-164 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011251 | MN -10 | 12:36485 |
| 87-1 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011228 | MN -70 | 12:36511 |
| 87-9 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011244 | MN -10 | 12:36486 |
| 87-10 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011242 | MN -70 | 12:36512 |
| 87-37 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011179 | MN -41 | 12:37821 |
| 87-49 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011183 | MN -16 | 12:36825 |
| 87-51 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011252 | MN -10 | 12:36513 |
| 87-55 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011180 | MN -10 | 12:36487 |
| 87-62 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011243 | MN -41 | 12:37457 |
| **DPST-** | | | | | |
| 85-704 | NTIS, PC A11/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011220 | MN -70B | 12:37826 |
| 85-856 | NTIS, PC A19/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011240 | MN -11 | 12:36549 |
| 85-953 | NTIS, PC A20; 3 | | DE87011239 | MN -70 | 12:36514 |
| **DTH-IMSOR-RR-** | | | | | |
| 1986-4 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752476 | MN -122 | 12:36385 |
| **DTH-LV-R-** | | | | | |
| 86-12 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752363 | MN -59A | 12:36702 |
| **E-** | | | | | |
| 3254 | *See* N-87-21257 | | | | 12:37496 |
| 3305 | *See* N-87-21077 | | | | 12:37230 |
| 3430 | *See* N-87-20566 | | | | 12:37229 |
| 3472 | *See* N-87-21043 | | | | 12:37346 |
| 3505 | *See* N-87-20421 | | | | 12:37344 |
| **ECTB-** | | | | | |
| 144-11B | *See* PB-87-183570/XAB | | | | 12:37676 |
| 152-18B | *See* PB-87-185625/XAB | | | | 12:37685 |
| 154-10 | *See* PB-87-189486/XAB | | | | 12:37699 |
| 163-11A | *See* PB-87-183596/XAB | | | | 12:37677 |
| **EFI-TR-** | | | | | |
| 3336 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87752494 | MN -97e | 12:36609 |
| **EGG-** | | | | | |
| 2379 | *See* NUREG/CR-4165 | | TI87010676 | MN -78 | 12:36919 |
| 2456 | *See* NUREG/CR-4617 | | TI87007999 | MN -80 | 12:36920 |
| 2508 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87010942 | STD -20e | 12:38378 |
| **EGG-M-** | | | | | |
| 00387 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87009345 | MN -2 | 12:36975 |
| 29786 | NTIS, PC A02; 3 | | DE87009398 | MN -70 | 12:36515 |
| **ENDF-** | | | | | |
| 344 | *See* ORNL/TM-10219 | | DE87011958 | MN -34C | 12:38274 |
| **ENEA-RT-COMB-** | | | | | |
| 86-1 | NTIS (US Sales Only), PC A05; 3 | | DE87752624 | MN -80 | 12:36798 |
| **ENEA-RT/FARE-** | | | | | |
| 84-4 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87752628 | MN -63 | 12:36645 |
| 85-3 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87752630 | MN -95f | 12:37141 |
| 86-7 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87752626 | MN -61E | 12:36992 |
| 86-8 | NTIS (US Sales Only), PC A09/MF A01; 1 | | DE87752627 | MN -11 | 12:37607 |
| **ENEA-RT-FUS-** | | | | | |
| 86-7 | NTIS (US Sales Only), PC A06; 3 | | DE87752631 | MN -20f | 12:38379 |
| 86-12 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752640 | MN -20a | 12:38335 |
| **ENEA-RT/STUDI-** | | | | | |
| 85-3 | NTIS (US Sales Only), PC A05/MF A01; 1 | | DE87752625 | MN -98 | 12:36980 |
| 86-3 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752641 | MN -11 | 12:37857 |
| **ENEA-RT-TIB-** | | | | | |
| 86-37 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752633 | MN -34 | 12:37475 |
| 86-38 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752634 | MN -34 | 12:37476 |
| 86-42 | NTIS (US Sales Only), PC A02/MF A01 | | DE87752637 | MN -34 | 12:37477 |
| 86-43 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752636 | MN -34 | 12:37478 |
| 86-44 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752638 | MN -34 | 12:37479 |
| 86-53 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752635 | MN -34 | 12:37480 |
| 86-59 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87752639 | MN -34 | 12:37481 |
| 86-61 | NTIS (US Sales Only), PC A02/MF A01; 1 | | DE87752632 | MN -28 | 12:37482 |
| **ENV-MER-** | | | | | |
| 80-053 | NTIS (US Sales Only), PC A09; 3 | | DE87752316 | MN -11 | 12:37608 |
| **EPA-** | | | | | |
| 450/ 3-81/ 003B | *See* PB-87-184669/XAB | | | | 12:37679 |
| 450/ 3-84/ 014B | *See* PB-87-178828/XAB | | | | 12:37650 |
| 450/ 3-87/ 008 | *See* PB-87-187860/XAB | | | | 12:37690 |
| 450/ 4-86/ 010A | *See* PB-87-183414/XAB | | | | 12:37674 |
| 450/ 4-86/ 018 | *See* PB-87-181236/XAB | | | | 12:37666 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 450/ 4-87/ 001 | *See* PB-87-180352/XAB | | | 12:37657 |
| 450/ 05-86/ 012 | *See* PB-87-176871/XAB | | | 12:37727 |
| 530/ SW-85/ 013 | *See* PB-87-173159/XAB | | | 12:37809 |
| 540/ 1-86/ 060 | *See* PB-87-183125/XAB | | | 12:37892 |
| 540/ 09-077 | *See* PB-87-175782/XAB | | | 12:37995 |
| 540/ G-86/ 001 | *See* PB-87-181939/XAB | | | 12:37811 |
| 560/ 2-87/ 001 | *See* PB-87-176004/XAB | | | 12:37891 |
| 600/ 6-87/ 001 | *See* PB-87-186151/XAB | | | 12:38002 |
| 600/ 7-86/ 056B | *See* PB-87-182879/XAB | | | 12:36763 |
| 600/ 8-86/ 020F | *See* PB-87-176574/XAB | | | 12:37642 |
| 600/ 8-87/ 001 | *See* PB-87-137733/XAB | | | 12:37990 |
| 600/ 9-86/ 028 | *See* PB-87-176541/XAB | | | 12:36965 |
| 600/ D-85/ 273 | *See* PB-87-187134/XAB | | | 12:38003 |
| 600/ D-87/ 070 | *See* PB-87-179271/XAB | | | 12:37652 |
| 600/ D-87/ 085 | *See* PB-87-174876/XAB | | | 12:37717 |
| 600/ D-87/ 093 | *See* PB-87-174892/XAB | | | 12:37718 |
| 600/ D-87/ 105 | *See* PB-87-175824/XAB | | | 12:37996 |
| 600/ D-87/ 114 | *See* PB-87-179990/XAB | | | 12:37655 |
| 600/ D-87/ 115 | *See* PB-87-180758/XAB | | | 12:37664 |
| 600/ D-87/ 117 | *See* PB-87-179248/XAB | | | 12:36332 |
| 600/ D-87/ 125 | *See* PB-87-181053/XAB | | | 12:37665 |
| 600/ D-87/ 129 | *See* PB-87-182697/XAB | | | 12:38001 |
| 600/ D-87/ 134 | *See* PB-87-182655/XAB | | | 12:37668 |
| 600/ D-87/ 136 | *See* PB-87-182671/XAB | | | 12:37670 |
| 600/ D-87/ 143 | *See* PB-87-188132/XAB | | | 12:38004 |
| 600/ D-87/ 168 | *See* PB-87-188108/XAB | | | 12:37691 |
| 600/ J-84/ 397 | *See* PB-87-174991/XAB | | | 12:37638 |
| 600/ J-84/ 399 | *See* PB-87-179974/XAB | | | 12:36333 |
| 600/ J-84/ 401 | *See* PB-87-180048/XAB | | | 12:37656 |
| 600/ J-84/ 403 | *See* PB-87-180659/XAB | | | 12:37662 |
| 600/ J-85/ 477 | *See* PB-87-174967/XAB | | | 12:37636 |
| 600/ J-86/ 282 | *See* PB-87-175600/XAB | | | 12:37994 |
| 600/ J-86/ 288 | *See* PB-87-175063/XAB | | | 12:37993 |
| 600/ J-86/ 289 | *See* PB-87-175048/XAB | | | 12:37639 |
| 600/ J-86/ 297 | *See* PB-87-175949/XAB | | | 12:37997 |
| 600/ J-86/ 308 | *See* PB-87-176699/XAB | | | 12:37646 |
| 600/ J-86/ 351 | *See* PB-87-185427/XAB | | | 12:37815 |
| 600/ J-87/ 014 | *See* PB-87-182648/XAB | | | 12:36334 |
| 600/ M-87/ 007 | *See* PB-87-175311/XAB | | | 12:37839 |
| **EPA/IMSD-** | | | | |
| 86/ 001 | *See* PB-87-186227/XAB | | | 12:37687 |
| 86/ 002 | *See* PB-87-186235/XAB | | | 12:37721 |
| 86/ 005 | *See* PB-87-185583/XAB | | | 12:36967 |
| **EPAIMSD-** | | | | |
| 87/ 002 | *See* PB-87-185500/XAB | | | 12:36966 |
| **EPRI-AP-** | | | | |
| 5220 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920460 | ND -60 12:36646 |
| 5221 | NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.) | E 1.99: | DE87011616 | MN -108 12:36273 |
| 5247 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920473 | ND -125 12:36429 |
| 5276 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920478 | ND -109 12:36751 |
| **EPRI-CS-** | | | | |
| 5198-Vol.2 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920492 | ND -105 12:37609 |
| 5198-Vol.3 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920493 | ND -105 12:37610 |
| 5235 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920500 | ND -101 12:36752 |
| **EPRI-EA-** | | | | |
| 5115 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920467 | ND -105 12:36328 |
| 5202 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920470 | ND -11 12:36617 |
| **EPRI-EL-** | | | | |
| 3359-Vol.3 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920436 | ND -97d 12:36753 |
| 4286-Vol.5 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920466 | ND -97b 12:36754 |
| 5179 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920474 | ND -97a 12:36770 |
| **EPRI-EM-** | | | | |
| 5175 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920480 | ND -98E 12:36995 |
| 5226 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920453 | ND -97 12:36996 |
| 5231 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920482 | ND -95f 12:37142 |
| 5232 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920472 | ND -95f 12:37143 |
| 5274 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | | TI87920485 | ND -25 12:37297 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **EPRI-NP-** | | | | |
| 4696-CCM-Vol.2 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920348 | ND -80 | 12:36814 |
| 4993 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920331 | ND -80 | 12:37219 |
| 5054-SR | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920306 | ND -80 | 12:36826 |
| 5150-M | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920454 | ND -78 | 12:36772 |
| 5228-Vol.1 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920456 | ND -80 | 12:36827 |
| 5228-Vol.2 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920455 | ND -80 | 12:36828 |
| **EPRI-P-** | | | | |
| 5160-SR | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920506 | ND -97 | 12:36997 |
| 5201 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920490 | ND -97 | 12:36610 |
| 5284 | Research Reports Center, Box 50490, Palo Alto, CA 94303 | TI87920494 | ND -98C | 12:36437 |
| **EPS-** | | | | |
| 3-PG-1 | Dearborn Environmental Consulting Services, Canada | | | 12:37849 |
| **EQL-** | | | | |
| 23 | *See* PB-87-179826/XAB | | | 12:37654 |
| **ERA-** | | | | |
| 85-0017 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36739 |
| **ES/ESH-** | | | | |
| 2 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: DE87011967 | MN -11 | 12:36960 |
| **ESA-CR(P)-** | | | | |
| 2291-VOL-2 | *See* SNIAS-59-CA/CG | | | 12:36637 |
| **ESA-TT-** | | | | |
| 68 | NTIS, PC A06/MF A01 | | | 12:37446 |
| **ETN-** | | | | |
| 87-99424 | *See* ESA-TT-68 | | | 12:37446 |
| 87-99483 | *See* SNIAS-59-CA/CG | | | 12:36637 |
| 87-99756 | *See* PREPRINT-42 | | | 12:38219 |
| **ETSU-B-** | | | | |
| 1052 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -61A | 12:36585 |
| 1074 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -61A | 12:36628 |
| 1077 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -61A | 12:36586 |
| 7006 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -61 | 12:36587 |
| **ETSU-G-** | | | | |
| 124A | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66a | 12:36723 |
| 124B | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66a | 12:36724 |
| 126A | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66d | 12:36727 |
| 126B-Pt.1 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66d | 12:36728 |
| 126C | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66d | 12:36729 |
| 126D | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66d | 12:36730 |
| 129A | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -66b | 12:36722 |
| **ETSU-STP-** | | | | |
| 1539(1) | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -97e | 12:36732 |
| 4042 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -97e | 12:36733 |
| **ETSU-WN-** | | | | |
| 0561/ 3 | *See* ERA-85-0017 | | ND -60 | 12:36739 |
| 1057/ 1 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36737 |
| 5018-1A | *See* YR-2788-Vol.1 | | ND -60 | 12:36744 |
| 5018-1B | *See* YR-2788-Vol.2 | | ND -60 | 12:36745 |
| 5031-1 | *See* TWC-P-8218 | | ND -60 | 12:36738 |
| 5055 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36740 |
| **EUR-** | | | | |
| 9080-FR | *See* PB-87-185559/XAB | | | 12:36276 |
| 9374 | Commission of the European Communities, Luxemburg | DE87751782 | MN -58 | 12:36619 |
| 9491 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752300 | MN -96 | 12:37162 |
| 9864 | NTIS (US Sales Only), PC A07; 3 | DE87751792 | MN -63 | 12:36629 |
| 9955 | Commission of the European Communities, Luxembourg | DE87752299 | ND -61A | 12:36630 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 9997-EN | *See* PB-87-185260/XAB | | | 12:36633 |
| 10044-DE | *See* PB-87-185724/XAB | | | 12:37183 |
| 10285 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752510 | MN -95d | 12:37068 |
| 10534e | *See* KFK-4165 | | ND -20d | 12:38381 |
| 10775-EN | Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities | | ND -4 | 12:36575 |
| 10836-EN | Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities | | ND -94a | 12:36938 |
| 10890-EN | Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities | | ND -61C | 12:36576 |
| **FAA-EE-** | | | | |
| 86-11-A-REV-1 | *See* AD-A-179286/0/XAB | | | 12:37599 |
| **FCR-** | | | | |
| 8244 | *See* PB-87-182200/XAB | | | 12:37013 |
| **FDA/CFSAN-** | | | | |
| 87/ 30 | *See* PB-87-175345/XAB | | | 12:36964 |
| **FNAL/C-** | | | | |
| 87/ 71 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010082 | MN -34D | 12:38125 |
| 87/ 82 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011067 | MN -34D | 12:38126 |
| **FNAL/Pub-** | | | | |
| 87/ 77-A | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010939 | MN -34B | 12:38058 |
| **FNAL-TM-** | | | | |
| 1444 | NTIS, PC A02; 3 | DE87009031 | STD -28 | 12:37543 |
| 1457 | NTIS, PC A02; 3 | DE87011001 | STD -32 | 12:38408 |
| 1458 | NTIS, PC A02; 3 | DE87011000 | STD -32 | 12:38409 |
| 1463 | NTIS, PC A02; 3 | DE87010995 | STD -32 | 12:38410 |
| **FRNC-TH-** | | | | |
| 1996 | NTIS (US Sales Only), PC A12/MF A01; 1 | DE87752319 | MN -98 | 12:36978 |
| 2377 | NTIS (US Sales Only), PC A06; 3 | DE87751772 | MN -95d | 12:37069 |
| **GA-A-** | | | | |
| 18775 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009301 | MN -20a | 12:38337 |
| 18842 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010651 | MN -20 | 12:38380 |
| **GEND-** | | | | |
| 061 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87010696 | STD -78 | 12:36829 |
| **GKSS-** | | | | |
| 86/ E/ 43 | NTIS PC E07; Available from NTIS as TIB/B87-04743 | | ND -37 | 12:37563 |
| 86/ E/ 57 | NTIS PC E07; Available from NTIS as TIB/B87-06347 | | ND -38 | 12:36809 |
| **GL-** | | | | |
| 4157 | *See* AD-A-179346/2/XAB | | | 12:37450 |
| **GRI-** | | | | |
| 87/ 0015 | *See* PB-87-185187/XAB | | | 12:37682 |
| **GRS-F-** | | | | |
| 155 | NTIS PC E07; Available from NTIS as TIB/B87-07018 | | ND -80 | 12:36830 |
| **GSF-** | | | | |
| 37/ 86 | NTIS PC E99; Available from NTIS as TIB/B87-07076 | | ND -48 | 12:37958 |
| **GSF-B-** | | | | |
| 1964 | NTIS PC E11; Available from NTIS as TIB/B87-06911 | | ND -48 | 12:37903 |
| **GSI-** | | | | |
| 86-55-Prepr. | NTIS PC E07; Available from NTIS as TIB/B87-04531 | | ND -34A | 12:38095 |
| 87-2-Prepr. | NTIS PC E07; Available from NTIS as TIB/B87-04774 | | ND -48 | 12:37904 |
| 87-3 | NTIS PC E09; Available from NTIS as TIB/B87-07044 | | ND -34C | 12:38252 |
| 87-7-Prepr. | NTIS PC E07; Available from NTIS as TIB/B87-04776 | | ND -34C | 12:38260 |
| **HAC-REF-E-** | | | | |
| 9915 | *See* AD-A-179226/6/XAB | | | 12:38091 |
| **HDL-SR-** | | | | |
| 87-1 | *See* AD-A-179366/0/XAB | | | 12:38293 |
| **HDL-TR-** | | | | |
| 2097 | *See* AD-A-179671/3/XAB | | | 12:37280 |
| **HEDL-SA-** | | | | |
| 3188 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010410 | MN -80 | 12:36788 |
| 3349 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009972 | MN -79b | 12:36820 |
| 3359 | NTIS, PC A02; 3 | DE87010411 | MN -79 | 12:36815 |
| 3418 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | A 1.99: DE87010412 | MN -20c | 12:37220 |
| 3491 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87009966 | MN -79 | 12:36783 |
| 3530 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010726 | MN -34C | 12:38245 |
| 3629 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009967 | MN -79h | 12:36831 |
| 3673-FP | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009968 | MN -25 | 12:37505 |
| **HEDL-TME-** | | | | |
| 85-22 | NTIS, PC A07/MF A01 (GPO Dep.) | E 1.99: DE87011598 | STD -70 | 12:36516 |
| **HETA-** | | | | |
| 82-059-1752 | *See* PB-87-188744/XAB | | | 12:37693 |
| 83-162-1746 | *See* PB-87-184701/XAB | | | 12:37680 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 84-458-1733 | *See* PB-87-174199/XAB | | | 12:37630 |
| 84-484-1754 | *See* PB-87-188785/XAB | | | 12:37694 |
| 85-018-1759 | *See* PB-87-189445/XAB | | | 12:37695 |
| 85-043-1760 | *See* PB-87-189478/XAB | | | 12:37698 |
| 85-044-1761 | *See* PB-87-189502/XAB | | | 12:37701 |
| 85-045-1762 | *See* PB-87-189510/XAB | | | 12:37702 |
| 85-046-1763 | *See* PB-87-189460/XAB | | | 12:37697 |
| 85-289-1738 | *See* PB-87-183521/XAB | | | 12:37675 |
| 85-306-1753 | *See* PB-87-188546/XAB | | | 12:37692 |
| 85-309-1739 | *See* PB-87-174256/XAB | | | 12:37631 |
| 85-416-1742 | *See* PB-87-174207/XAB | | | 12:37890 |
| 85-441-1765 | *See* PB-87-188538/XAB | | | 12:36291 |
| 85-462-1748 | *See* PB-87-183604/XAB | | | 12:37678 |
| 85-482-1730 | *See* PB-87-174108/XAB | | | 12:37626 |
| 85-518-1737 | *See* PB-87-174173/XAB | | | 12:37629 |
| 86-018-1758 | *See* PB-87-189452/XAB | | | 12:37696 |
| 86-037-1749 | *See* PB-87-185575/XAB | | | 12:37683 |
| 86-045-1681 | *See* PB-87-163366/XAB | | | 12:37623 |
| 86-223-1743 | *See* PB-87-174090/XAB | | | 12:37625 |
| 86-277-1750 | *See* PB-87-187837/XAB | | | 12:37689 |
| 86-339-1741 | *See* PB-87-174140/XAB | | | 12:37628 |
| 86-348-1756 | *See* PB-87-189528/XAB | | | 12:37703 |
| 86-403-1747 | *See* PB-87-185609/XAB | | | 12:37684 |
| 86-477-1755 | *See* PB-87-189494/XAB | | | 12:37700 |
| **HL-** | | | | |
| 86-1377-C-8 | *See* AERE-R-10812-Rev. | DE87900761 | MN -79a | 12:37576 |
| **HSD-TR-** | | | | |
| 87-005 | *See* AD-A-179163/1/XAB | | | 12:37185 |
| **IAEA-CN-** | | | | |
| 47/ A-III-1 | *See* DOE/ET/51013-206 | E 1.99: DE87010005 | MN -20f | 12:38326 |
| **ICASE-** | | | | |
| 87-18 | *See* N-87-20780 | | | 12:37442 |
| **IDA-P-** | | | | |
| 1983 | *See* AD-A-179298/5/XAB | | | 12:37186 |
| **IEA/ICEAS/B-** | | | | |
| 4 | NTIS (US Sales Only), PC A04/MF A01 | TI87900844 | STD -105 | 12:37611 |
| **IEA/ICTIS/TR-** | | | | |
| 37 | NTIS (US Sales Only), PC A04/MF A01 | TI87900799 | STD -116 | 12:36340 |
| **IEA-SHAC-TVI-** | | | | |
| 2 | NTIS (US Sales Only), PC A04; 3 | DE87900818 | MN -59B | 12:36683 |
| 3 | NTIS (US Sales Only), PC A04; 3 | DE87900827 | MN -59A | 12:36703 |
| **IFP-** | | | | |
| 33-261 | NTIS (US Sales Only), PC A17/MF A01; 1 | DE87752317 | MN -4 | 12:37375 |
| 33-325 | NTIS (US Sales Only), PC A12/MF A01; 1 | DE87752318 | MN -125 | 12:36409 |
| 33-507 | NTIS (US Sales Only), MF A01; 2 | DE87751771 | MN -11 | 12:38042 |
| 34-367-1 | NTIS (US Sales Only), PC A12/MF A01; 1 | DE87752314 | MN -61 | 12:36598 |
| 34-367-2 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752315 | MN -61 | 12:36599 |
| **IFSR-** | | | | |
| 213 | *See* DOE/ET/53088-213 | E 1.99: DE87010764 | MN -20g | 12:38329 |
| 254 | *See* DOE/ET/53088-254 | E 1.99: DE87010765 | MN -20g | 12:38330 |
| 275 | *See* DOE/ET/53088-275 | E 1.99: DE87010788 | MN -20g | 12:38331 |
| 276 | *See* DOE/ET/53088-276 | E 1.99: DE87010766 | MN -20f | 12:38332 |
| 277 | *See* DOE/ET/53088-277 | E 1.99: DE87010767 | MN -20g | 12:38333 |
| 279 | *See* DOE/ET/53088-279 | E 1.99: DE87010768 | MN -20g | 12:38334 |
| **IFU-B-** | | | | |
| 55-83 | Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung | | ND -95e | 12:37144 |
| **IFUSP-P-** | | | | |
| 524 | NTIS (US Sales Only), PC A02; 3 | DE87900800 | MN -34 | 12:38395 |
| **IIUG-pre-** | | | | |
| 85-14 | NTIS PC E07; Available from NTIS as TIB/B87-06482 | | ND -48 | 12:37897 |
| 85-21 | NTIS PC E07; Available from NTIS as TIB/B87-06483 | | ND -95d | 12:37070 |
| **IIUG-rep-** | | | | |
| 85-11 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87770176 | MN -98 | 12:36950 |
| 86-8 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE87770177 | MN -98 | 12:36951 |
| **IKU-R-** | | | | |
| 05.1704.00/ 01/ 84 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752485 | MN -121 | 12:36419 |
| **IL/SGS/ENG-** | | | | |
| 117 | *See* PB-87-187159/XAB | | | 12:37562 |
| **IPP-** | | | | |
| III-117 | NTIS PC E11; Available from NTIS as TIB/B87-07050 | | ND -20f | 12:38338 |
| **IS-J-** | | | | |
| 2454 | *See* DOE/ER/40200-091 | E 1.99: DE87010914 | MN -34D | 12:38163 |
| 2469 | *See* DOE/ER/40200-092 | E 1.99: DE87010915 | MN -34D | 12:38164 |
| **IS-T-** | | | | |
| 1276 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87010921 | MN -37 | 12:37458 |
| 1279 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87010932 | MN -34 | 12:37337 |
| 1281 | NTIS, PC A06/MF A01 (GPO Dep.) | E 1.99: DE87010927 | MN -34 | 12:37338 |
| 1292 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87011254 | MN -4 | 12:37397 |
| 1293 | NTIS, PC A10/MF A01; 1 (GPO Dep.) | E 1.99: DE87011255 | MN -4 | 12:37398 |
| 1294 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87011256 | MN -4 | 12:37399 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| **ISH-** | | | | |
| 35-Ed.2 | NTIS PC E17; Available from NTIS as TIB/B87-04721 | | ND -48 | 12:37898 |
| 36 | NTIS PC E11; Available from NTIS as TIB/B86-09852 | | ND -4 | 12:37438 |
| 48 | NTIS PC E09; Available from NTIS as TIB/B86-09853 | | ND -4 | 12:37439 |
| 49 | NTIS PC E17; Available from NTIS as TIB/B87-04683 | | ND -48 | 12:37899 |
| 56 | NTIS PC E09; Available from NTIS as TIB/B86-09856 | | ND -4 | 12:37440 |
| 92 | NTIS PC E11; Available from NTIS as TIB/B87-04775 | | ND -48 | 12:37905 |
| 99 | NTIS PC E11; Available from NTIS as TIB/B87-06474 | | ND -11 | 12:37710 |
| **ITP-UH-** | | | | |
| 15/ 86 | *See* DESY-86-156 | | ND -34D | 12:38156 |
| **IVO-A-** | | | | |
| 07/ 86 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752483 | MN -95d | 12:37071 |
| **Juel-** | | | | |
| 2090 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87770178 | MN -93 | 12:36577 |
| **Juel-Spez-** | | | | |
| 377 | NTIS (US Sales Only), PC A19/MF A01; 1 | | MN -34D | 12:36410 |
| **K/SUB-** | | | | |
| 85-22224/ 3 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011802 | MN -13 | 12:36517 |
| 85-22224/ 5 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87011801 | MN -13 | 12:36518 |
| **K/TS-** | | | | |
| 11-869 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87010226 | MN -22 | 12:36479 |
| **KC-** | | | | |
| 86/ 01d | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752366 | MN -95d | 12:37156 |
| **KFK-** | | | | |
| 4159 | NTIS PC E17; Available from NTIS as TIB/B87-07048 | | ND -13 | 12:38231 |
| 4165 | NTIS PC E09; Available from NTIS as TIB/B87-07049 | | ND -20d | 12:38381 |
| 4173 | NTIS PC E07; Available from NTIS as TIB/B87-04529 | | ND -25 | 12:37298 |
| 4174 | NTIS PC E07; Available from NTIS as TIB/B87-04742 | | ND -25 | 12:37299 |
| 4196 | NTIS PC E11; Available from NTIS as TIB/B87-07019 | | ND -48 | 12:37864 |
| **KMSF-U-** | | | | |
| 1566 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010884 | MN -21 | 12:38339 |
| **KTH-KTR-** | | | | |
| 86-57 | *See* STEV-BF-86-10 | DE87752396 | MN -109 | 12:36277 |
| **L-** | | | | |
| 16055 | *See* N-87-20814 | | | 12:36704 |
| 16261 | *See* N-87-20514 | | | 12:36462 |
| **LA-** | | | | |
| 10625-MS-Rev. | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87006307 | MN -33 | 12:36821 |
| 10730-MS-Vol.2 | *See* NUREG/CR-4615-Vol.2 | TI87009181 | MN -70B | 12:37850 |
| 10874 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87012050 | MN -34 | 12:37581 |
| 10929-MS | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87009465 | STD -70 | 12:36519 |
| 10977-MS | *See* NUREG/CR-4892 | TI87010786 | MN -80 | 12:36805 |
| 10989-T | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: DE87010835 | STD -34 | 12:38298 |
| 10992-ENV | NTIS, PC A14/MF A01; 1 (GPO Dep.) | E 1.99: DE87010215 | STD -41 | 12:37711 |
| 11059-MS | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87012106 | MN -11 | 12:37594 |
| **LA-tr-** | | | | |
| 87-13 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011135 | MN -48 | 12:38015 |
| **LA-UR-** | | | | |
| 87-1000 | NTIS, PC A02; 3 | DE87007456 | MN -80 | 12:36803 |
| 87-1531 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010105 | MN -59A | 12:36684 |
| 87-1535 | NTIS, PC A02; 3 | DE87010106 | MN -37 | 12:37483 |
| 87-1544 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010108 | MN -20f | 12:38340 |
| 87-1561 | NTIS, PC A02; 3 | DE87010110 | MN -20d | 12:38341 |
| 87-1673 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011066 | MN -25 | 12:37300 |
| 87-1714 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010126 | MN -38 | 12:37484 |
| 87-1739 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010129 | MN -4 | 12:37400 |
| 87-1748 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010131 | MN -48 | 12:37959 |
| 87-1952 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011783 | MN -15 | 12:36560 |
| 87-1964 | NTIS, PC A02; 3 | DE87011781 | MN -45 | 12:37582 |
| 87-2107 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011755 | MN -13 | 12:38396 |
| 87-2116 | NTIS, PC A02; 3 | DE87011752 | MN -15 | 12:36561 |
| 87-2117 | NTIS, PC A02; 3 | DE87011751 | MN -15 | 12:36562 |
| 87-2119 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011749 | MN -25 | 12:38306 |
| 87-2134 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011743 | MN -25 | 12:37221 |
| 87-2160 | NTIS, PC A02; 3 | DE87011737 | MN -25 | 12:37222 |
| 87-2198 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011733 | MN -25 | 12:37223 |
| 87-2252 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011330 | MN -70 | 12:36520 |
| **LAL-** | | | | |
| 85/ 50 | *See* DESY-86-012 | | ND -34D | 12:38116 |
| **LBL-** | | | | |
| 20545 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011091 | MN -95d | 12:37072 |
| 20896 | NTIS, PC A03; 3 | DE87010285 | MN -95d | 12:37073 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| 22189 | NTIS, PC A02; 3 | | DE87009548 | MN -28 | 12:37560 |
| 22193 | NTIS, PC A02; 3 | | DE87009550 | MN -28 | 12:37561 |
| 22476 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011104 | MN -25 | 12:37224 |
| 22477 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011028 | MN -25 | 12:37225 |
| 22718 | NTIS, PC A02; 3 | | DE87006147 | MN -70 | 12:38043 |
| 22747 | NTIS, PC A02; 3 | | DE87006944 | MN -11 | 12:38044 |
| 22991 | NTIS, PC A15/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011216 | MN -34 | 12:38299 |
| 22992 | NTIS, PC A12/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012137 | MN -4 | 12:37401 |
| 23122 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010260 | MN -34D | 12:38218 |
| 23136 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009164 | MN -11 | 12:37712 |
| 23259 | NTIS, PC A03; 3 | | DE87011090 | MN -32 | 12:38411 |
| 23299 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010263 | MN -20 | 12:38342 |
| 23307 | NTIS, PC A14/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012093 | MN -4 | 12:38096 |
| 23312 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010740 | MN -105 | 12:36329 |
| 23342 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011211 | MN -32 | 12:38103 |
| 23352 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010279 | MN -105 | 12:36330 |
| 23381 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011213 | MN -34C | 12:38261 |
| 23427 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010985 | MN -25 | 12:37339 |
| 23442 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010976 | MN -25 | 12:37196 |
| 23452 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011103 | MN -34D | 12:37564 |
| 23462 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011223 | MN -25 | 12:37340 |
| 23477 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011224 | MN -11 | 12:38037 |
| 23508 | NTIS, PC A11/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010850 | MN -34C | 12:37506 |
| 23512 | NTIS, PC A10; 3 | | DE87011841 | MN -25 | 12:37513 |
| 23530 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011100 | MN -25 | 12:37226 |
| 23532 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011096 | MN -25 | 12:37227 |
| 23533 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011097 | MN -4 | 12:37228 |
| 23536 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87012032 | MN -25 | 12:37514 |
| 23570 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011914 | MN -34C | 12:38239 |
| 23578 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012058 | MN -4 | 12:38308 |
| 23579 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012031 | MN -4 | 12:37402 |
| **LMSC/F-** | | | | | |
| 195926 | *See* AD-A-179245/6/XAB | | | | 12:37198 |
| **MHSMP-** | | | | | |
| 87-18 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012069 | STD -11 | 12:36550 |
| **MITNRL-** | | | | | |
| 022 | *See* DOE/ER/75173-1 | E 1.99: | DE87010406 | MN -80 | 12:36819 |
| **MLM-** | | | | | |
| 3428(OP) | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009197 | MN -25 | 12:37341 |
| 3436(OP) | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009196 | MN -95d | 12:37074 |
| 3441 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012325 | STD -13 | 12:36563 |
| 3442(OP) | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011840 | MN -45 | 12:37583 |
| **MPI-PAE/Exp.El.-** | | | | | |
| 156 | NTIS PC E07; Available from NTIS as TIB/B87-03946 | | | ND -37 | 12:37565 |
| **MTR-** | | | | | |
| 86W00213 | *See* NUREG/CR-4783 | | TI87900769 | MN -80 | 12:36926 |
| **N-** | | | | | |
| 87-20386 | NTIS, PC A04/MF A01 | | | | 12:37342 |
| 87-20387 | NTIS, PC A06/MF A01 | | | | 12:37343 |
| 87-20399 | NTIS, PC A08/MF A01 | | | | 12:37441 |
| 87-20400 | NTIS, PC A03/MF A01 | | | | 12:37376 |
| 87-20421 | NTIS, PC A02/MF A01 | | | | 12:37344 |
| 87-20501 | NTIS, PC A02/MF A01 | | | | 12:37494 |
| 87-20514 | NTIS, PC A02/MF A01 | | | | 12:36462 |
| 87-20566 | NTIS, PC A01/MF A01 | | | | 12:37229 |
| 87-20780 | NTIS, PC A02/MF A01 | | | | 12:37442 |
| 87-20802 | NTIS, PC A05/MF A01 | | | | 12:37491 |
| 87-20813 | NTIS, PC A03/MF A01 | | | | 12:38273 |
| 87-20814 | NTIS, PC A02/MF A01 | | | | 12:36704 |
| 87-20820 | NTIS, PC A04/MF A01 | | | | 12:37345 |
| 87-20840 | NTIS, PC A02/MF A01 | | | | 12:37566 |
| 87-20860 | NTIS, PC A02/MF A01 | | | | 12:38061 |
| 87-20947 | NTIS, PC A03/MF A01 | | | | 12:38062 |
| 87-20951 | NTIS, PC A04/MF A01 | | | | 12:37567 |
| 87-20968 | NTIS, PC A05/MF A01 | | | | 12:37495 |
| 87-21043 | NTIS, PC A03/MF A01 | | | | 12:37346 |
| 87-21077 | NTIS, PC A03/MF A01 | | | | 12:37230 |
| 87-21257 | NTIS, PC A11/MF A01 | | | | 12:37496 |
| 87-21427 | NTIS, PC A02/MF A01 | | | | 12:38087 |
| 87-21684 | NTIS, PC A02/MF A01 | | | | 12:38343 |
| 87-21763 | NTIS, PC A05/MF A01 | | | | 12:38063 |
| **NAMRL-** | | | | | |
| 1328 | *See* AD-A-180111/7/XAB | | | | 12:38013 |
| **NAS-** | | | | | |
| 1.15:88500 | *See* N-87-20802 | | | | 12:37491 |
| 1.15:88527 | *See* N-87-20399 | | | | 12:37441 |
| 1.15:89063 | *See* N-87-20814 | | | | 12:36704 |
| 1.15:89069 | *See* N-87-20386 | | | | 12:37342 |
| 1.15:89119 | *See* N-87-20968 | | | | 12:37495 |
| 1.15:89844 | *See* N-87-20421 | | | | 12:37344 |
| 1.15:89846 | *See* N-87-21043 | | | | 12:37346 |
| 1.15:89866 | *See* N-87-21077 | | | | 12:37230 |
| 1.26:4052 | *See* N-87-21257 | | | | 12:37496 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 1.26:4054 | *See* N-87-20813 | | | 12:38273 |
| 1.26:4064 | *See* N-87-20501 | | | 12:37494 |
| 1.26:174733 | *See* N-87-20387 | | | 12:37343 |
| 1.26:178245 | *See* N-87-20400 | | | 12:37376 |
| 1.26:178269 | *See* N-87-20780 | | | 12:37442 |
| 1.26:179027 | *See* N-87-20820 | | | 12:37345 |
| 1.26:179037 | *See* N-87-20951 | | | 12:37567 |
| 1.26:180107 | *See* N-87-20840 | | | 12:37566 |
| 1.26:180220 | *See* N-87-21684 | | | 12:38343 |
| 1.26:180497 | *See* N-87-20860 | | | 12:38061 |
| 1.26:180508 | *See* N-87-21427 | | | 12:38087 |
| 1.26:180513 | *See* N-87-21763 | | | 12:38063 |
| 1.60:2682 | *See* N-87-20514 | | | 12:36462 |
| 1.60:2711 | *See* N-87-20566 | | | 12:37229 |
| 1.60:2714 | *See* N-87-20947 | | | 12:38062 |
| **NASA-CR-** | | | | |
| 4052 | *See* N-87-21257 | | | 12:37496 |
| 4054 | *See* N-87-20813 | | | 12:38273 |
| 4064 | *See* N-87-20501 | | | 12:37494 |
| 174733 | *See* N-87-20387 | | | 12:37343 |
| 178245 | *See* N-87-20400 | | | 12:37376 |
| 178269 | *See* N-87-20780 | | | 12:37442 |
| 179027 | *See* N-87-20820 | | | 12:37345 |
| 179037 | *See* N-87-20951 | | | 12:37567 |
| 180107 | *See* N-87-20840 | | | 12:37566 |
| 180220 | *See* N-87-21684 | | | 12:38343 |
| 180497 | *See* N-87-20860 | | | 12:38061 |
| 180508 | *See* N-87-21427 | | | 12:38087 |
| 180513 | *See* N-87-21763 | | | 12:38063 |
| **NASA-TM-** | | | | |
| 88500 | *See* N-87-20802 | | | 12:37491 |
| 88527 | *See* N-87-20399 | | | 12:37441 |
| 89063 | *See* N-87-20814 | | | 12:36704 |
| 89069 | *See* N-87-20386 | | | 12:37342 |
| 89119 | *See* N-87-20968 | | | 12:37495 |
| 89844 | *See* N-87-20421 | | | 12:37344 |
| 89846 | *See* N-87-21043 | | | 12:37346 |
| 89866 | *See* N-87-21077 | | | 12:37230 |
| 89896 | *See* DOE/NASA/17088-5 | DE87011605 | STD -11 | 12:37012 |
| **NASA-TP-** | | | | |
| 2682 | *See* N-87-20514 | | | 12:36462 |
| 2711 | *See* N-87-20566 | | | 12:37229 |
| 2714 | *See* N-87-20947 | | | 12:38062 |
| **NCAR-TN-** | | | | |
| 278-STR | *See* PB-87-173605/XAB | | | 12:38064 |
| **NCRP-** | | | | |
| 87 | National Council on Radiation Protection and Measurements, 7910 Woodmont Ave., Bethesda, MD 20814 | TI87900845 | ND -41 | 12:37877 |
| 88 | National Council on Radiation Protection and Measurements, 7910 Woodmont Ave., Bethesda, MD 20814 | TI87900829 | ND -41 | 12:37459 |
| **NEI-DK-** | | | | |
| 19 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752364 | MN -97e | 12:36734 |
| 20 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752365 | MN -60 | 12:36741 |
| 21 | NTIS (US Sales Only), PC A14; 3 | DE87752474 | MN -25 | 12:36943 |
| 22 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752367 | MN -97e | 12:36618 |
| 23 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752368 | MN -97e | 12:36611 |
| 24 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752369 | MN -97e | 12:36612 |
| 25 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE87752370 | MN -97e | 12:36613 |
| 26 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752371 | MN -97b | 12:36998 |
| 27 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752473 | MN -95 | 12:37075 |
| 28 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752472 | MN -11 | 12:38038 |
| 29 | NTIS (US Sales Only), PC A06; 3 | DE87752475 | MN -97e | 12:36614 |
| **NILU-F-** | | | | |
| 18/ 84 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752500 | MN -11 | 12:37621 |
| **NIVA-O-** | | | | |
| 82007 | NTIS (US Sales Only), PC A11; 3 | DE87752501 | MN -121 | 12:36420 |
| 82073 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752495 | MN -11 | 12:37622 |
| **NLH/IBT/R-** | | | | |
| 196 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752496 | MN -95 | 12:37145 |
| **NMRDI-** | | | | |
| 2-74-4625 | NTIS, PC A04/MF A01 - NMRDI, 1220 South St. Francis Dr., Santa Fe, NM 87501; 1 | DE87900811 | MN -59A | 12:36685 |
| **NOAA-TM-ERL-ARL-** | | | | |
| 152 | *See* PB-87-183000/XAB | | | 12:37671 |
| **NOAA/TM-ERL-PMEL-** | | | | |
| 69 | *See* PB-87-178273/XAB | | | 12:37842 |
| **NP-** | | | | |
| 7752456 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752456 | MN -96 | 12:37163 |
| 7752459 | NTIS (US Sales Only), PC A02/MF A01 | DE87752459 | MN -11 | 12:36961 |
| 7770107 | NTIS (US Sales Only), PC A09/MF A01; 1 | DE87770107 | MN -96 | 12:37164 |
| 7770108 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE87770108 | MN -96 | 12:37165 |
| 7770109 | NTIS (US Sales Only), PC A10/MF A01; 1 | DE87770109 | MN -59B | 12:37076 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| 7770110 | NTIS (US Sales Only), PC A10/MF A01; 1 | | DE87770110 | MN -121 | 12:36985 |
| 7770111 | NTIS (US Sales Only), PC A08; 3 | | DE87770111 | MN -94 | 12:37405 |
| 7770112 | NTIS (US Sales Only), PC A09/MF A01; 1 | | DE87770112 | MN -38 | 12:37526 |
| 7770113 | NTIS (US Sales Only), PC A06/MF A01; 1 | | DE87770113 | MN -38 | 12:37497 |
| 7770114 | NTIS (US Sales Only), PC A07/MF A01; 1 | | DE87770114 | MN -48 | 12:38014 |
| 7770115 | NTIS (US Sales Only), PC A08/MF A01; 1 | | DE87770115 | MN -108 | 12:36274 |
| 7770116 | NTIS (US Sales Only), PC A08/MF A01; 1 | | DE87770116 | MN -95f | 12:37146 |
| 7770117 | NTIS (US Sales Only), PC A11; 3 | | DE87770117 | MN -41 | 12:37985 |
| 7770118 | NTIS (US Sales Only), PC A15/MF A01; 1 | | DE87770118 | MN -48 | 12:37986 |
| 7770119 | NTIS (US Sales Only), PC A09/MF A01; 1 | | DE87770119 | MN -94 | 12:36936 |
| 7770120 | NTIS (US Sales Only), PC A07/MF A01; 1 | | DE87770120 | MN -61E | 12:36631 |
| 7770121 | NTIS (US Sales Only), PC A11/MF A01; 1 | | DE87770121 | MN -38 | 12:37498 |
| 7770122 | NTIS (US Sales Only), PC A10/MF A01; 1 | | DE87770122 | MN -4 | 12:37443 |
| 7770123 | NTIS (US Sales Only), PC A08/MF A01; 1 | | DE87770123 | MN -48 | 12:37987 |
| 7770124 | NTIS (US Sales Only), PC A07; 3 | | DE87770124 | MN -62a | 12:36686 |
| 7770125 | NTIS (US Sales Only), PC A06/MF A01; 1 | | DE87770125 | MN -122 | 12:36386 |
| 7770135 | NTIS (US Sales Only), PC A07/MF A01; 1 | | DE87770135 | MN -11 | 12:37598 |
| 7900796 | NTIS (US Sales Only), PC A09/MF A01; 1 | | DE87900796 | MN -2 | 12:38232 |
| 7900834 | NTIS (US Sales Only), PC A12; 3 | | DE87900834 | MN -13 | 12:38397 |
| **NU-** | | | | | |
| 33/ 87 | *See* OEFZS-4385 | | | ND -48 | 12:37988 |
| 35/ 87 | *See* OEFZS-4389 | | | ND -48 | 12:37989 |
| **NUREG-** | | | | | |
| 0540-Vol.9-No.2 | NTIS, PC A18/MF A01 - GPO | | TI87900774 | MN -2 | 12:36790 |
| 0540-Vol.9-No.4 | NTIS, PC A21 - GPO | | DE87900839 | MN -2 | 12:36791 |
| 0728-Rev.2 | NTIS, PC A03/MF A01 - GPO | | TI87900776 | MN -80 | 12:36833 |
| 0750-Vol.24-Index.1 | NTIS, PC A04 - GPO | | DE87900771 | MN -78 | 12:36792 |
| 0750-Vol.25-No.1 | NTIS, PC A04 - GPO | | DE87900854 | MN -2 | 12:36793 |
| 0936-Vol.6-No.1 | NTIS, PC A07/MF A01 - GPO | | TI87900837 | MN -2 | 12:36794 |
| 0940-Vol.5-No.4 | NTIS, PC A25 - GPO | | DE87900540 | MN -80 | 12:36976 |
| 1147-Rev.1 | NTIS, PC A11/MF A01 - GPO | | TI87900813 | MN -80 | 12:36834 |
| 1259 | NTIS, PC A19/MF A01 - GPO | | TI87900762 | MN -78 | 12:36835 |
| 1272 | NTIS, PC A11/MF A01 - GPO | | TI87900765 | MN -80 | 12:36836 |
| **NUREG/CR-** | | | | | |
| 2000-Vol.6-No.1 | NTIS, PC A06/MF A01 - GPO | | TI87006889 | MN -80 | 12:36795 |
| 2000-Vol.6-No.2 | NTIS, PC A06/MF A01 - GPO | | TI87008297 | MN -80 | 12:36796 |
| 2000-Vol.6-No.4 | NTIS, PC A07/MF A01 - GPO | | TI87010804 | MN -2 | 12:36797 |
| 3231 | NTIS, PC A05/MF A01 - GPO | | TI87010802 | MN -78 | 12:36778 |
| 4082-Vol.5 | NTIS, PC A11/MF A01 - GPO | | TI87900596 | MN -80 | 12:36804 |
| 4098 | NTIS, PC A07/MF A01 - GPO | | TI87008181 | MN -80 | 12:36918 |
| 4165 | NTIS, PC A05/MF A01 - GPO | | TI87010676 | MN -78 | 12:36919 |
| 4615-Vol.2 | NTIS, PC A11/MF A01 - GPO | | TI87009181 | MN -70B | 12:37850 |
| 4617 | NTIS PC E04/MF A01 - GPO | | TI87007999 | MN -80 | 12:36920 |
| 4653 | NTIS PC E12/MF A01 - GPO | | TI87011019 | MN -41 | 12:37931 |
| 4674-Vol.3 | NTIS, PC A07/MF A01 | | TI87010610 | MN -78 | 12:36921 |
| 4674-Vol.4 | NTIS, PC A23 - GPO | | DE87010611 | MN -78 | 12:36922 |
| 4679 | NTIS, PC A08/MF A01 - GPO | | TI87010662 | MN -80 | 12:36923 |
| 4681 | NTIS, PC A05/MF A01 - GPO | | TI87010663 | MN -80 | 12:36924 |
| 4726 | NTIS, PC A10/MF A01 - GPO | | TI87900879 | MN -41 | 12:36554 |
| 4772 | NTIS, PC A08/MF A01 - GPO | | TI87010664 | MN -80 | 12:36925 |
| 4783 | NTIS, PC A09/MF A01 - GPO | | TI87900769 | MN -80 | 12:36926 |
| 4830 | NTIS, PC A10/MF A01 - GPO | | TI87010665 | MN -78 | 12:36927 |
| 4860 | NTIS, PC A03/MF A01 - GPO | | TI87009373 | MN -78 | 12:36773 |
| 4892 | NTIS, PC A03/MF A01 - GPO | | TI87010786 | MN -80 | 12:36805 |
| 4897 | NTIS, PC A06/MF A01 - GPO | | TI87011275 | MN -70B | 12:36521 |
| 4903-Vol.3 | NTIS, PC A09/MF A01 - GPO | | TI87900768 | MN -80 | 12:36928 |
| 4928 | NTIS, PC A05/MF A01 - GPO | | TI87900824 | MN -78 | 12:36774 |
| 4964 | NTIS, PC A04/MF A01 - GPO | | TI87010608 | MN -78 | 12:36799 |
| **NZERDC-** | | | | | |
| 135 | *See* PB-87-173100/XAB | | | | 12:36952 |
| 137 | *See* PB-87-184370/XAB | | | | 12:36954 |
| **NZERDC-P-** | | | | | |
| 114 | NTIS (US Sales Only), PC A08/MF A01; 1 | | DE87900816 | MN -60 | 12:36735 |
| 116 | NTIS (US Sales Only), PC A03/MF A01; 1 | | DE87900821 | MN -95f | 12:37147 |
| **OCS/MMS-** | | | | | |
| 87/ 0029 | *See* PB-87-182135/XAB | | | | 12:37835 |
| **OEFZS-** | | | | | |
| 4385 | Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. | | | ND -48 | 12:37988 |
| 4389 | Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. | | | ND -48 | 12:37989 |
| **ONERA-NT-** | | | | | |
| 1983-3 | *See* ESA-TT-68 | | | | 12:37446 |
| **ORNL-** | | | | | |
| 6369 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011965 | MN -61B | 12:36632 |
| 6380 | NTIS, PC A13/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011964 | STD -2 | 12:36750 |
| 6397 | NTIS, PC A04; 3 | | DE87011963 | STD -48 | 12:37859 |
| 6405 | NTIS, PC A05/MF A01 (GPO Dep.) | E 1.99: | DE87011962 | MN -11 | 12:36962 |
| **ORNL/CON-** | | | | | |
| 196 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011978 | MN -95d | 12:37077 |
| 229 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011977 | MN -95d | 12:37078 |
| **ORNL/ESH-** | | | | | |
| 1/ V23 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011973 | MN -11 | 12:36963 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| **ORNL/M-** | | | | | |
| 341 | *See* DOE/HWP-25 | E 1.99: | DE87011968 | STD -69 | 12:36959 |
| **ORNL/NOAC-** | | | | | |
| 232-Vol.3 | *See* NUREG/CR-4674-Vol.3 | | TI87010610 | MN -78 | 12:36921 |
| 232-Vol.4 | *See* NUREG/CR-4674-Vol.4 | | DE87010611 | MN -78 | 12:36922 |
| **ORNL/NSIC-** | | | | | |
| 200-Vol.6-No.1 | *See* NUREG/CR-2000-Vol.6-No.1 | | TI87006889 | MN -80 | 12:36795 |
| 200-Vol.6-No.2 | *See* NUREG/CR-2000-Vol.6-No.2 | | TI87008297 | MN -80 | 12:36796 |
| 200-Vol.6-No.4 | *See* NUREG/CR-2000-Vol.6-No.4 | | TI87010804 | MN -2 | 12:36797 |
| **ORNL/Sub-** | | | | | |
| 85-21674/ 1 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87011976 | STD -70 | 12:36522 |
| 85-27488/ 01 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011983 | MN -114 | 12:37231 |
| **ORNL/TM-** | | | | | |
| 9681 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011971 | MN -70 | 12:36523 |
| 9821 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011970 | MN -103 | 12:36362 |
| 10112 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011961 | MN -70 | 12:38039 |
| 10206/ P1 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011959 | MN -114 | 12:36755 |
| 10219 | NTIS, PC A06; 3 | | DE87011958 | MN -34C | 12:38274 |
| 10289 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011957 | STD -70 | 12:36524 |
| 10309 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011955 | STD -4 | 12:37377 |
| 10338 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011954 | STD -11 | 12:36525 |
| 10359 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011953 | STD -86 | 12:36488 |
| 10364 | *See* NUREG/CR-4860 | | TI87009373 | MN -78 | 12:36773 |
| 10377 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011952 | MN -48 | 12:37878 |
| 10402 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011949 | STD -25 | 12:37378 |
| 10403 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011948 | MN -114 | 12:37301 |
| 10421 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87010582 | MN -37 | 12:37568 |
| 10474 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011889 | MN -70 | 12:36526 |
| **ORO-** | | | | | |
| 5126-307 | *See* DOE/ER/05126-307 | E 1.99: | DE87007376 | MN -34C | 12:38267 |
| **OTA-A-** | | | | | |
| 275 | *See* PB-87-177846/XAB | | | | 12:36974 |
| 327 | *See* PB-87-177812/XAB | | | | 12:36973 |
| **PATENTS-GB-** | (GB: Comptroller-General, The Patent Office (Sale Branch), St. Mary Cray, Orpington, Kent, BR 53rd, UK, 0.25 pounds per copy) | | | | |
| 2,176,925/ A/ | | | | | 12:36542 |
| **PATENTS-US-** | (US: Commissioner of Patents, Washington, DC 20231, USA, $1.50 per copy.) | | | | |
| 4,665,277 | | | | | 12:36641 |
| 4,665,526 | | | | | 12:37490 |
| 4,667,922 | | | | | 12:37471 |
| 4,668,165 | | | | | 12:37166 |
| 4,668,464 | | | | | 12:38367 |
| 4,669,085 | | | | | 12:37489 |
| 4,670,405 | | | | | 12:37707 |
| **PB-** | | | | | |
| 87-137733/ XAB | NTIS, PC A05/MF A01 | | | | 12:37990 |
| 87-141602/ XAB | NTIS PC PC E99/MF E99 | | | | 12:37168 |
| 87-141610/ XAB | NTISPC$38.50/MF$16.50 | | | | 12:37169 |
| 87-141628/ XAB | NTISPC$32.50/MF$16.50 | | | | 12:37170 |
| 87-141636/ XAB | NTISPC$22.50/MF$16.50 | | | | 12:37171 |
| 87-141651/ XAB | NTIS PC PC E99/MF E99 | | | | 12:37172 |
| 87-141677/ XAB | NTISPC$317.00/MF$27.50 | | | | 12:37173 |
| 87-141685/ XAB | NTISPC$239.50/MF$24.00 | | | | 12:37174 |
| 87-141693/ XAB | NTISPC$250.50/MF$40.00 | | | | 12:37175 |
| 87-141735/ XAB | NTISPC$76.00/MF$17.00 | | | | 12:37176 |
| 87-141743/ XAB | NTISPC$215.00/MF$23.50 | | | | 12:37177 |
| 87-141768/ XAB | NTISPC$110.00/MF$19.00 | | | | 12:37178 |
| 87-141776/ XAB | NTISPC$39.00/MF$16.50 | | | | 12:37179 |
| 87-141792/ XAB | NTISPC$301.50/MF$35.50 | | | | 12:37180 |
| 87-163366/ XAB | NTIS, PC A02/MF A01 | | | | 12:37623 |
| 87-169488/ XAB | NTIS, PC A06/MF A01 | | | | 12:37991 |
| 87-171377/ XAB | NTIS, PC A02/MF A01 | | | | 12:36366 |
| 87-171682/ XAB | NTIS, PC A06/MF A01 | | | | 12:37992 |
| 87-171906/ XAB | NTIS, PC A07/MF A01 | | | | 12:37624 |
| 87-171989/ XAB | NTISCP T02 | | | | 12:36999 |
| 87-172342/ XAB | NTIS PC PC E99/MF E99 | | | | 12:37181 |
| 87-172359/ XAB | NTISPC$80.00/MF$17.50 | | | | 12:37182 |
| 87-173100/ XAB | NTIS PC PC E04/MF E01 | | | | 12:36952 |
| 87-173118/ XAB | NTIS, PC A03/MF A01 | | | | 12:37507 |
| 87-173159/ XAB | NTIS, PC A04/MF A01 | | | | 12:37809 |
| 87-173167/ XAB | NTIS, PC A04/MF A01 | | | | 12:36551 |
| 87-173175/ XAB | NTIS, PC A05/MF A01 | | | | 12:37827 |
| 87-173209/ XAB | NTIS, PC A14/MF A01 | | | | 12:37888 |
| 87-173381/ XAB | NTIS, PC A04/MF A01 | | | | 12:37000 |
| 87-173605/ XAB | NTIS, PC A02/MF A01 | | | | 12:38064 |
| 87-173613/ XAB | NTIS, PC A03/MF A01 | | | | 12:37485 |
| 87-173886/ XAB | NTIS, PC A13/MF A01 | | | | 12:36588 |
| 87-173936/ XAB | NTIS PC PC E07/MF E01 | | | | 12:37499 |
| 87-174058/ XAB | NTIS, PC A99/MF E04 | | | | 12:37003 |
| 87-174090/ XAB | NTIS, PC A02/MF A01 | | | | 12:37625 |
| 87-174108/ XAB | NTIS, PC A05/MF A01 | | | | 12:37626 |
| 87-174132/ XAB | NTIS, PC A02/MF A01 | | | | 12:37627 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 87-174140/ XAB | NTIS, PC A02/MF A01 | | | 12:37628 |
| 87-174165/ XAB | NTIS, PC A02/MF A01 | | | 12:37889 |
| 87-174173/ XAB | NTIS, PC A02/MF A01 | | | 12:37629 |
| 87-174199/ XAB | NTIS, PC A03/MF A01 | | | 12:37630 |
| 87-174207/ XAB | NTIS, PC A03/MF A01 | | | 12:37890 |
| 87-174256/ XAB | NTIS, PC A03/MF A01 | | | 12:37631 |
| 87-174397/ XAB | NTIS, PC A02/MF A01 | | | 12:37632 |
| 87-174629/ XAB | NTIS, PC A02/MF A01 | | | 12:37633 |
| 87-174827/ XAB | NTIS, PC A03/MF A01 | | | 12:37634 |
| 87-174850/ XAB | NTIS, PC A03/MF A01 | | | 12:37635 |
| 87-174876/ XAB | NTIS, PC A02/MF A01 | | | 12:37717 |
| 87-174884/ XAB | NTIS, PC A04/MF A01 | | | 12:37810 |
| 87-174892/ XAB | NTIS, PC A02/MF A01 | | | 12:37718 |
| 87-174918/ XAB | NTIS, PC A09/MF A01 | | | 12:36465 |
| 87-174967/ XAB | NTIS, PC A02/MF A01 | | | 12:37636 |
| 87-174975/ XAB | NTIS, PC A02/MF A01 | | | 12:37637 |
| 87-174991/ XAB | NTIS, PC A02/MF A01 | | | 12:37638 |
| 87-175006/ XAB | NTIS, PC A02/MF A01 | | | 12:37719 |
| 87-175048/ XAB | NTIS, PC A02/MF A01 | | | 12:37639 |
| 87-175063/ XAB | NTIS, PC A02/MF A01 | | | 12:37993 |
| 87-175311/ XAB | NTIS, PC A02/MF A01 | | | 12:37839 |
| 87-175345/ XAB | NTIS, PC A17/MF A01 | | | 12:36964 |
| 87-175519/ XAB | NTIS, PC A10/MF A01 | | | 12:37640 |
| 87-175568/ XAB | NTIS, PC A08/MF A01 | | | 12:37726 |
| 87-175576/ XAB | NTIS, PC A05/MF A01 | | | 12:37641 |
| 87-175600/ XAB | NTIS, PC A02/MF A01 | | | 12:37994 |
| 87-175782/ XAB | NTIS, PC A05/MF A01 | | | 12:37995 |
| 87-175824/ XAB | NTIS, PC A03/MF A01 | | | 12:37996 |
| 87-175832/ XAB | NTIS, PC A02/MF A01 | | | 12:36761 |
| 87-175857/ XAB | NTIS, PC A03/MF A01 | | | 12:36331 |
| 87-175949/ XAB | NTIS, PC A02/MF A01 | | | 12:37997 |
| 87-176004/ XAB | NTIS, PC A20/MF A01 | | | 12:37891 |
| 87-176269/ XAB | NTIS, PC A06/MF A01 | | | 12:37840 |
| 87-176277/ XAB | NTIS, PC A03/MF A01 | | | 12:37841 |
| 87-176426/ XAB | NTIS, PC A02/MF A01 | | | 12:37720 |
| 87-176541/ XAB | NTIS, PC A05/MF A01 | | | 12:36965 |
| 87-176574/ XAB | NTIS, PC A10/MF A01 | | | 12:37642 |
| 87-176608/ XAB | NTIS, PC A02/MF A01 | | | 12:37643 |
| 87-176624/ XAB | NTIS, PC A02/MF A01 | | | 12:37644 |
| 87-176632/ XAB | NTIS, PC A02/MF A01 | | | 12:37645 |
| 87-176699/ XAB | NTIS, PC A02/MF A01 | | | 12:37646 |
| 87-176871/ XAB | NTIS, PC A05/MF A01 | | | 12:37727 |
| 87-176921/ XAB | NTIS PC PC E03/MF E01 | | | 12:37647 |
| 87-177341/ XAB | NTIS, PC A02/MF A01 | | | 12:37648 |
| 87-177515/ XAB | NTIS, PC A19/MF A01 | | | 12:37649 |
| 87-177523/ XAB | NTIS, PC A06/MF A01 | | | 12:36606 |
| 87-177531/ XAB | NTIS, PC A21/MF A01 | | | 12:36607 |
| 87-177812/ XAB | NTIS, PC A07/MF A01 | | | 12:36973 |
| 87-177846/ XAB | NTIS, PC A07/MF A01 | | | 12:36974 |
| 87-178257/ XAB | NTIS, PC A12/MF A01 | | | 12:37099 |
| 87-178273/ XAB | NTIS, PC A03/MF A01 | | | 12:37842 |
| 87-178299/ XAB | NTIS, PC A04/MF A01 | | | 12:36756 |
| 87-178828/ XAB | NTIS, PC A03/MF A01 | | | 12:37650 |
| 87-179115/ XAB | NTIS, PC A06/MF A01 | | | 12:37998 |
| 87-179248/ XAB | NTIS, PC A02/MF A01 | | | 12:36332 |
| 87-179255/ XAB | NTIS, PC A03/MF A01 | | | 12:37522 |
| 87-179263/ XAB | NTIS, PC A02/MF A01 | | | 12:37651 |
| 87-179271/ XAB | NTIS, PC A02/MF A01 | | | 12:37652 |
| 87-179289/ XAB | NTIS, PC A02/MF A01 | | | 12:37653 |
| 87-179297/ XAB | NTIS, PC A02/MF A01 | | | 12:37157 |
| 87-179826/ XAB | NTIS, PC A16/MF A01 | | | 12:37654 |
| 87-179974/ XAB | NTIS, PC A02/MF A01 | | | 12:36333 |
| 87-179990/ XAB | NTIS, PC A03/MF A01 | | | 12:37655 |
| 87-180048/ XAB | NTIS, PC A02/MF A01 | | | 12:37656 |
| 87-180352/ XAB | NTIS, PC A11/MF A01 | | | 12:37657 |
| 87-180360/ XAB | NTIS, PC A03/MF A01 | | | 12:37658 |
| 87-180584/ XAB | NTIS, PC A20/MF A01 | | | 12:37659 |
| 87-180592/ XAB | NTIS, PC A10/MF A01 | | | 12:37660 |
| 87-180600/ XAB | NTIS, PC A06/MF A01 | | | 12:37661 |
| 87-180659/ XAB | NTIS, PC A02/MF A01 | | | 12:37662 |
| 87-180667/ XAB | NTIS, PC A02/MF A01 | | | 12:37663 |
| 87-180758/ XAB | NTIS, PC A02/MF A01 | | | 12:37664 |
| 87-181053/ XAB | NTIS, PC A02/MF A01 | | | 12:37665 |
| 87-181095/ XAB | NTIS, PC A02/MF A01 | | | 12:36589 |
| 87-181137/ XAB | NTIS, PC A02/MF A01 | | | 12:37999 |
| 87-181194/ XAB | NTIS, PC A05/MF A01 | | | 12:38065 |
| 87-181202/ XAB | NTIS, PC A03/MF A01 | | | 12:38066 |
| 87-181236/ XAB | NTIS, PC A05/MF A01 | | | 12:37666 |
| 87-181582/ XAB | NTIS, PC A03/MF A01 | | | 12:37843 |
| 87-181921/ XAB | NTIS, PC A03/MF A01 | | | 12:36762 |
| 87-181939/ XAB | NTIS, PC A04/MF A01 | | | 12:37811 |
| 87-181962/ XAB | NTIS, PC A08/MF A01 | | | 12:36458 |
| 87-181970/ XAB | NTIS, PC A04/MF A01 | | | 12:36460 |
| 87-182077/ XAB | NTIS, PC A04/MF A01 | | | 12:37667 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| 87-182101/ XAB | NTIS, PC A03/MF A01 | | | 12:38000 |
| 87-182135/ XAB | NTIS, PC A04/MF A01 | | | 12:37835 |
| 87-182192/ XAB | NTIS, PC A06/MF A01 | | | 12:36578 |
| 87-182200/ XAB | NTIS, PC A03/MF A01 | | | 12:37013 |
| 87-182218/ XAB | NTIS, PC A07/MF A01 | | | 12:37500 |
| 87-182283/ XAB | NTIS, PC A07/MF A01 | | | 12:36953 |
| 87-182614/ XAB | NTIS, PC A02/MF A01 | | | 12:37158 |
| 87-182630/ XAB | NTIS, PC A03/MF A01 | | | 12:37844 |
| 87-182648/ XAB | NTIS, PC A02/MF A01 | | | 12:36334 |
| 87-182655/ XAB | NTIS, PC A02/MF A01 | | | 12:37668 |
| 87-182663/ XAB | NTIS, PC A03/MF A01 | | | 12:37669 |
| 87-182671/ XAB | NTIS, PC A03/MF A01 | | | 12:37670 |
| 87-182697/ XAB | NTIS, PC A02/MF A01 | | | 12:38001 |
| 87-182879/ XAB | NTISCP T02 | | | 12:36763 |
| 87-182887/ XAB | NTIS, PC A08/MF A01 | | | 12:36764 |
| 87-183000/ XAB | NTIS, PC A04/MF A01 | | | 12:37671 |
| 87-183067/ XAB | NTIS, PC A04/MF A01 | | | 12:37672 |
| 87-183125/ XAB | NTIS, PC A09/MF A01 | | | 12:37892 |
| 87-183133/ XAB | NTIS, PC A10/MF A01 | | | 12:37812 |
| 87-183141/ XAB | NTIS, PC A07/MF A01 | | | 12:37813 |
| 87-183158/ XAB | NTIS, PC A16/MF A01 | | | 12:36969 |
| 87-183182/ XAB | NTIS, PC A03/MF A01 | | | 12:36341 |
| 87-183216/ XAB | NTIS, PC A02/MF A01 | | | 12:36348 |
| 87-183240/ XAB | NTIS, PC A04/MF A01 | | | 12:37673 |
| 87-183414/ XAB | NTIS, PC A04/MF A01 | | | 12:37674 |
| 87-183489/ XAB | NTIS, PC A03/MF A01 | | | 12:36365 |
| 87-183521/ XAB | NTIS, PC A06/MF A01 | | | 12:37675 |
| 87-183570/ XAB | NTIS, PC A03/MF A01 | | | 12:37676 |
| 87-183588/ XAB | NTIS, PC A02/MF A01 | | | 12:36275 |
| 87-183596/ XAB | NTIS, PC A02/MF A01 | | | 12:37677 |
| 87-183604/ XAB | NTIS, PC A02/MF A01 | | | 12:37678 |
| 87-184115/ XAB | NTIS, PC A06/MF A01 | | | 12:36590 |
| 87-184198/ XAB | NTIS, PC A06/MF A01 | | | 12:38067 |
| 87-184271/ XAB | NTIS, PC A08/MF A01 | | | 12:37079 |
| 87-184305/ XAB | NTIS, PC A08/MF A01 | | | 12:36463 |
| 87-184313/ XAB | NTIS, PC A02/MF A01 | | | 12:36464 |
| 87-184370/ XAB | NTIS PC PC E04/MF E01 | | | 12:36954 |
| 87-184578/ XAB | NTIS, PC A23/MF A01 | | | 12:37814 |
| 87-184644/ XAB | NTIS, PC A02/MF A01 | | | 12:37595 |
| 87-184669/ XAB | NTIS, PC A05/MF A01 | | | 12:37679 |
| 87-184701/ XAB | NTIS, PC A03/MF A01 | | | 12:37680 |
| 87-184859/ XAB | NTIS, PC A03/MF A01 | | | 12:36970 |
| 87-184925/ XAB | NTIS, PC A05/MF A01 | | | 12:37681 |
| 87-184933/ XAB | NTIS, PC A04/MF A01 | | | 12:37100 |
| 87-185088/ XAB | NTIS, PC A05/MF A01 | | | 12:37851 |
| 87-185104/ XAB | NTIS, PC A03/MF A01 | | | 12:36955 |
| 87-185187/ XAB | NTIS, PC A05/MF A01 | | | 12:37682 |
| 87-185203/ XAB | NTIS, PC A05/MF A01 | | | 12:36439 |
| 87-185260/ XAB | NTIS PC PC E03/MF E03 | | | 12:36633 |
| 87-185302/ XAB | NTIS, PC A25/MF A01 | | | 12:36424 |
| 87-185427/ XAB | NTIS, PC A02/MF A01 | | | 12:37815 |
| 87-185500/ XAB | NTIS, PC A10/MF A01 | | | 12:36966 |
| 87-185559/ XAB | NTIS PC PC E04/MF E04 | | | 12:36276 |
| 87-185575/ XAB | NTIS, PC A02/MF A01 | | | 12:37683 |
| 87-185583/ XAB | NTIS, PC A15/MF A01 | | | 12:36967 |
| 87-185609/ XAB | NTIS, PC A02/MF A01 | | | 12:37684 |
| 87-185625/ XAB | NTIS, PC A03/MF A01 | | | 12:37685 |
| 87-185724/ XAB | NTIS PC PC E03/MF E03 | | | 12:37183 |
| 87-185849/ XAB | NTIS PC PC E03/MF E01 | | | 12:36425 |
| 87-185971/ XAB | NTIS, PC A08/MF A01 | | | 12:37686 |
| 87-186003/ XAB | NTIS, PC A18/MF A01 | | | 12:37101 |
| 87-186151/ XAB | NTIS, PC A18/MF A01 | | | 12:38002 |
| 87-186227/ XAB | NTIS, PC A04/MF A01 | | | 12:37687 |
| 87-186235/ XAB | NTIS, PC A06/MF A01 | | | 12:37721 |
| 87-186292/ XAB | NTIS, PC A11/MF A01 | | | 12:37845 |
| 87-186383/ XAB | NTIS, PC A05/MF A01 | | | 12:38068 |
| 87-187076/ XAB | NTIS, PC A02/MF A01 | | | 12:37688 |
| 87-187134/ XAB | NTIS, PC A02/MF A01 | | | 12:38003 |
| 87-187159/ XAB | NTIS, PC A06/MF A01 | | | 12:37562 |
| 87-187837/ XAB | NTIS, PC A03/MF A01 | | | 12:37689 |
| 87-187860/ XAB | NTIS, PC A05/MF A01 | | | 12:37690 |
| 87-188108/ XAB | NTIS, PC A02/MF A01 | | | 12:37691 |
| 87-188132/ XAB | NTIS, PC A04/MF A01 | | | 12:38004 |
| 87-188348/ XAB | NTIS PC PC E05/MF E05 | | | 12:37102 |
| 87-188538/ XAB | NTIS, PC A02/MF A01 | | | 12:36291 |
| 87-188546/ XAB | NTIS, PC A02/MF A01 | | | 12:37692 |
| 87-188744/ XAB | NTIS, PC A02/MF A01 | | | 12:37693 |
| 87-188751/ XAB | NTIS, PC A02/MF A01 | | | 12:36342 |
| 87-188785/ XAB | NTIS, PC A02/MF A01 | | | 12:37694 |
| 87-188892/ XAB | NTIS, PC A18/MF A01 | | | 12:36765 |
| 87-188991/ XAB | NTIS, PC A04/MF A01 | | | 12:36480 |
| 87-189445/ XAB | NTIS, PC A03/MF A01 | | | 12:37695 |
| 87-189452/ XAB | NTIS, PC A02/MF A01 | | | 12:37696 |
| 87-189460/ XAB | NTIS, PC A03/MF A01 | | | 12:37697 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| 87-189478/ XAB | NTIS, PC A03/MF A01 | | | | 12:37698 |
| 87-189486/ XAB | NTIS, PC A03/MF A01 | | | | 12:37699 |
| 87-189494/ XAB | NTIS, PC A02/MF A01 | | | | 12:37700 |
| 87-189502/ XAB | NTIS, PC A03/MF A01 | | | | 12:37701 |
| 87-189510/ XAB | NTIS, PC A03/MF A01 | | | | 12:37702 |
| 87-189528/ XAB | NTIS, PC A02/MF A01 | | | | 12:37703 |
| 87-189676/ XAB | NTIS, PC A05/MF A01 | | | | 12:36349 |
| 87-189817/ XAB | NTIS, PC A02/MF A01 | | | | 12:36343 |
| 87-190567/ XAB | NTIS, PC A10/MF A01 | | | | 12:37184 |
| 87-900300/ XAB | NTISSubscription | | | | 12:38005 |
| 87-904200/ XAB | NTISSubscription | | | | 12:36968 |
| 87-928600/ XAB | NTISSubscription | | | | 12:36986 |
| **PC/ICE/R-** | | | | | |
| 51 | *See* PB-87-184115/XAB | | | | 12:36590 |
| **PFC/CP-** | | | | | |
| 86-20 | *See* DOE/ET/51013-206 | E 1.99: | DE87010005 | MN -20f | 12:38326 |
| 87-6 | *See* DOE/ET/51013-218 | | DE87011033 | MN -20 | 12:38327 |
| 87-9 | *See* DOE/ET/51013-221 | E 1.99: | DE87011036 | MN -20a | 12:38328 |
| **PFO-** | | | | | |
| 1410 | NTIS (US Sales Only), PC A04/MF A01; 1 | | DE87752484 | MN -121 | 12:36421 |
| **PNL-** | | | | | |
| 5751 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011629 | MN -11 | 12:37816 |
| 5779 | *See* NUREG/CR-3231 | | TI87010802 | MN -78 | 12:36778 |
| 5881 | NTIS, PC A05/MF A01 (GPO Dep.) | E 1.99: | DE87010614 | MN -95d | 12:37080 |
| 5907 | *See* NUREG/CR-4653 | | TI87011019 | MN -41 | 12:37931 |
| 5953 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011697 | MN -95a | 12:37103 |
| 5979 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011107 | MN -61D | 12:38006 |
| 6036 | NTIS, PC A04/MF A01 (GPO Dep.) | E 1.99: | DE87009787 | MN -70 | 12:37722 |
| 6148 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011108 | MN -70B | 12:36527 |
| 6162 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011698 | MN -85 | 12:36493 |
| 6176 | NTIS, PC A07/MF A01 (GPO Dep.) | E 1.99: | DE87011231 | MN -95d | 12:37081 |
| 6189 | NTIS, PC A06/MF A01 (GPO Dep.) | E 1.99: | DE87011996 | MN -85 | 12:36494 |
| 6208 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012503 | MN -95c | 12:37148 |
| 6251 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012070 | MN -94e | 12:36939 |
| 6261 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012500 | MN -70 | 12:36489 |
| **PNL-SA-** | | | | | |
| 13792 | *See* UNI-SA-166 | E 1.99: | DE87007840 | MN -80 | 12:36810 |
| 14022 | NTIS, PC A02; 3 | | DE87011336 | MN -62b | 12:36655 |
| 14190 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011156 | MN -41 | 12:37932 |
| 14225 | NTIS, PC A16/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011680 | MN -41 | 12:36555 |
| 14244 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012025 | MN -4 | 12:37569 |
| 14276 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011185 | MN -4 | 12:38045 |
| 14315 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011153 | MN -61D | 12:36591 |
| 14377 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011148 | MN -4 | 12:36592 |
| 14400 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011152 | MN -4 | 12:37406 |
| 14426 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011138 | MN -70 | 12:36528 |
| 14497 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011337 | MN -25 | 12:37302 |
| 14499 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011186 | MN -70 | 12:36478 |
| 14605 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011988 | MN -95 | 12:37014 |
| 14624 | NTIS, PC A02/MF 01 (GPO Dep.) | E 1.99: | DE87011995 | MN -70 | 12:36529 |
| 14744 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011145 | MN -25 | 12:37303 |
| 14767 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87011155 | MN -70 | 12:36530 |
| 14768 | NTIS, PC A02; 3 | | DE87011146 | MN -11 | 12:37704 |
| 14976 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011994 | MN -13 | 12:38016 |
| **PNL/SRP-** | | | | | |
| 6253 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011272 | MN -70 | 12:36531 |
| **PPPL-** | | | | | |
| 2368 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010626 | STD -20g | 12:38344 |
| 2400 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010627 | STD -20g | 12:38345 |
| 2402 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010628 | STD -20f | 12:38346 |
| 2419 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010629 | STD -20f | 12:38347 |
| 2420 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010630 | STD -20g | 12:38348 |
| 2421 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010631 | STD -20a | 12:38382 |
| 2422 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010632 | STD -20g | 12:38349 |
| 2424 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010633 | STD -20g | 12:38350 |
| 2425 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010634 | STD -20f | 12:38351 |
| 2427 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010635 | STD -20g | 12:38352 |
| 2431 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010636 | STD -20g | 12:38353 |
| **PREPRINT-** | | | | | |
| 42 | NTIS, PC A02/MF A01 | | | | 12:38219 |
| **PWA-** | | | | | |
| 5890-24 | *See* N-87-20387 | | | | 12:37343 |
| **PWRRC-TR-** | | | | | |
| 155 | *See* PB-87-183182/XAB | | | | 12:36341 |
| **REPT-** | | | | | |
| 86-30019 | *See* PB-87-182218/XAB | | | | 12:37500 |
| 680 | *See* PB-87-184305/XAB | | | | 12:36463 |
| 800C-VOL-3 | *See* PB-87-185302/XAB | | | | 12:36424 |
| 6657 | *See* N-87-20400 | | | | 12:37376 |
| **RESOURCE PUB-** | | | | | |
| 164 | *See* PB-87-182101/XAB | | | | 12:38000 |
| **RF-T-** | | | | | |
| 41/ 84 | NTIS (US Sales Only), PC A08/MF A01; 1 | | DE87752486 | MN -122 | 12:36387 |
| 45/ 84 | NTIS (US Sales Only), PC A04/MF A01 | | DE87752487 | MN -121 | 12:36422 |

| Report Number | Availability Source | File Number | | Distribution Category | Abstract Number |
|---|---|---|---|---|---|
| **RFP-** | | | | | |
| 3987 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87012303 | STD -25 | 12:37232 |
| 4046 | NTIS, PC A05/MF A01 (GPO Dep.) | E 1.99: | DE87012300 | STD -25 | 12:37233 |
| 4105 | NTIS, PC A03; 3 | | DE87011053 | MN -47 | 12:36484 |
| 4106 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011054 | MN -47 | 12:36490 |
| 4119 | NTIS, PC A02; 3 | | DE87011056 | MN -4 | 12:37379 |
| 4124 | NTIS, PC A03; 3 | | DE87011050 | MN -41 | 12:37933 |
| 4128 | NTIS, PC A03; 3 | | DE87011049 | MN -47 | 12:36491 |
| **RFP-ENV-** | | | | | |
| 86 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011603 | MN -11 | 12:37723 |
| **RFP-Trans-** | | | | | |
| 465 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008183 | MN -80 | 12:36807 |
| **RHO-RE-SA-** | | | | | |
| 182 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010688 | MN -70 | 12:36532 |
| **RI-** | | | | | |
| 86-13 | *See* PB-87-183489/XAB | | | | 12:36365 |
| **RT-** | | | | | |
| 17/ 86 | *See* PB-87-188348/XAB | | | | 12:37102 |
| **SAI-** | | | | | |
| 84-1567-VOL-2 | *See* AD-B-090882/2/XAB | | | | 12:37591 |
| 84-1567-VOL-3 | *See* AD-B-090883/0/XAB | | | | 12:37592 |
| **SAIC-** | | | | | |
| 87/ 1584 | *See* AD-A-179377/7/XAB | | | | 12:37597 |
| **SAND-** | | | | | |
| 83-0768 | NTIS, PC A14/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010623 | MN -70 | 12:36533 |
| 84-2631 | *See* NUREG/CR-4098 | | TI87008181 | MN -80 | 12:36918 |
| 84-7208 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012345 | MN -70 | 12:36534 |
| 85-0008 | NTIS PC E04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012507 | MN -70 | 12:37822 |
| 85-2317-Rev. | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010522 | STD -62 | 12:36687 |
| 85-2568 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011608 | MN -25 | 12:37238 |
| 85-7100 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011576 | MN -70 | 12:38046 |
| 85-7208 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012509 | MN -70 | 12:36535 |
| 86-0173 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011907 | STD -45 | 12:36579 |
| 86-0236 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010992 | MN -37 | 12:37578 |
| 86-0311 | *See* NUREG/CR-4679 | | TI87010662 | MN -80 | 12:36923 |
| 86-0587 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011609 | MN -13 | 12:37515 |
| 86-0929 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012343 | MN -70 | 12:36536 |
| 86-0977 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009351 | MN -70 | 12:36537 |
| 86-1266 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012505 | MN -94cb | 12:36944 |
| 86-1296 | *See* NUREG/CR-4681 | | TI87010663 | MN -80 | 12:36924 |
| 86-1457C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010033 | MN -80 | 12:36800 |
| 86-1606C | NTIS, PC A02; 3 | | DE87009295 | MN -38 | 12:37579 |
| 86-1996 | *See* NUREG/CR-4772 | | TI87010664 | MN -80 | 12:36925 |
| 86-2165 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011606 | MN -62 | 12:36656 |
| 86-2447C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87006657 | MN -71 | 12:37460 |
| 86-2470 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012504 | STD -71 | 12:37461 |
| 86-2670C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010779 | MN -25 | 12:37239 |
| 86-2689 | *See* NUREG/CR-4830 | | TI87010665 | MN -78 | 12:36927 |
| 86-2750C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87009060 | MN -25 | 12:37304 |
| 86-2774C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87005849 | MN -38 | 12:37508 |
| 86-2823C | NTIS, PC A02; 3 | | DE87010435 | MN -62c | 12:36657 |
| 86-2828C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87009289 | MN -59A | 12:36658 |
| 86-2869C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010494 | MN -80 | 12:36929 |
| 86-2874 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011578 | MN -34 | 12:38300 |
| 86-2883C | NTIS, PC A02; 3 | | DE87009499 | MN -123 | 12:36466 |
| 86-2884C | NTIS, PC A02; 3 | | DE87009501 | MN -123 | 12:36467 |
| 86-2986C | NTIS, PC A02; 3 | | DE87011859 | MN -15 | 12:36564 |
| 86-7036-Vol.1 | NTIS, PC A18/MF A01; 1 | | DE87011607 | MN -63 | 12:36647 |
| 86-7133 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010529 | MN -70 | 12:36538 |
| 87-0002C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011860 | MN -13 | 12:38398 |
| 87-0071C | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010741 | MN -25 | 12:37240 |
| 87-0094C | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87005870 | MN -71 | 12:37462 |
| 87-0115 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011586 | MN -70 | 12:36539 |
| 87-0146C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010477 | MN -4 | 12:37380 |
| 87-0176 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011611 | MN -70 | 12:36540 |
| 87-0178 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011585 | MN -70 | 12:37347 |
| 87-0180C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87005536 | MN -13 | 12:36565 |
| 87-0184 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010531 | STD -78 | 12:36930 |
| 87-0273C | NTIS, PC A02; 3 | | DE87005875 | MN -38 | 12:37463 |
| 87-0283C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010738 | MN -15 | 12:37596 |
| 87-0315 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012340 | MN -25 | 12:37348 |
| 87-0393 | NTIS, PC A02/MF A01; 1 | | DE87011582 | MN -94c | 12:36945 |
| 87-0403C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87006129 | MN -34C | 12:37516 |
| 87-0404C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87010739 | MN -25 | 12:37349 |
| 87-0501 | NTIS, PC A04/MF A01 (GPO Dep.) | E 1.99: | DE87010532 | MN -60 | 12:36742 |
| 87-0620 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87012314 | MN -25 | 12:37350 |
| 87-0622C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87011059 | MN -25 | 12:37241 |
| 87-0636C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: | DE87010431 | MN -25 | 12:37351 |
| 87-0638C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87007864 | MN -80 | 12:36789 |
| 87-0641C | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011317 | MN -71 | 12:37464 |
| 87-0682C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008510 | MN -4 | 12:36593 |
| 87-0683C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87008509 | MN -4 | 12:36600 |
| 87-0706 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: | DE87012514 | MN -126 | 12:36428 |
| 87-0741C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: | DE87011637 | MN -25 | 12:37242 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| 87-0765C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011064 | MN -34 | 12:38301 |
| 87-0800C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011861 | MN -13 | 12:38399 |
| 87-0804C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009296 | MN -63 | 12:36648 |
| 87-0922C | NTIS, PC A02; 3 | DE87011718 | MN -66 | 12:36726 |
| 87-0947C | NTIS, PC A02; 3 | DE87011858 | MN -15 | 12:36566 |
| 87-0977C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011855 | MN -15 | 12:36567 |
| 87-1022C | NTIS, PC A02; 3 | DE87011867 | MN -15 | 12:36568 |
| 87-1038C | NTIS, PC A02; 3 | DE87011866 | MN -15 | 12:36569 |
| 87-1091C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010496 | MN -80 | 12:36806 |
| 87-1114C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010735 | MN -38 | 12:38412 |
| 87-1128C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009290 | MN -15 | 12:36570 |
| 87-1224C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009502 | MN -78 | 12:36571 |
| 87-1227 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87012511 | MN -13 | 12:38047 |
| 87-1306C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010034 | MN -93 | 12:37008 |
| 87-1402C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010513 | MN -4 | 12:37407 |
| 87-1632C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011320 | MN -25 | 12:37517 |
| 87-1654C | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011313 | MN -4 | 12:37408 |
| 87-1702C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012363 | MN -71 | 12:37465 |
| 87-7115C | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009503 | MN -94cb | 12:36946 |
| 87-8008 | NTIS, PC A03/MF A01 (GPO Dep.) | E 1.99: DE87011696 | MN -62a | 12:36659 |
| **SAPR-** | | | | |
| 6 | *See* N-87-20840 | | | 12:37566 |
| 7 | *See* N-87-20840 | | | 12:37566 |
| 8 | *See* N-87-20840 | | | 12:37566 |
| 32 | *See* N-87-21763 | | | 12:38063 |
| 33 | *See* N-87-21763 | | | 12:38063 |
| **SC-** | | | | |
| 5444-AR | *See* AD-A-179146/6/XAB | | | 12:37278 |
| **SCIENTIFIC-** | | | | |
| 21 | *See* AD-A-179430/4/XAB | | | 12:38018 |
| **SERI/SP-** | | | | |
| 231-2878 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87001170 | MN -61 | 12:36601 |
| **SERI/STR-** | | | | |
| 211-3127 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87001168 | STD -63 | 12:36634 |
| 211-3148 | NTIS, PC A11/MF A01; 1 (GPO Dep.) | E 1.99: DE87001173 | STD -63 | 12:36635 |
| 211-3149 | NTIS, PC A10; 3 | DE87001172 | STD -63 | 12:36705 |
| 255-3040 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87001167 | MN -59A | 12:36706 |
| **SERI/TR-** | | | | |
| 211-3052 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87001165 | MN -63 | 12:36636 |
| **SFB-** | | | | |
| 162-85-04-141 | NTIS PC E07; Available from NTIS as TIB/B87-06947 | | ND -20f | 12:38354 |
| **SGD-** | | | | |
| 510-PT-1 | *See* PB-87-181194/XAB | | | 12:38065 |
| 510-PT-2 | *See* PB-87-181202/XAB | | | 12:38066 |
| 511-PT-2 | *See* PB-87-186383/XAB | | | 12:38068 |
| **SI-** | | | | |
| 85-4-23-Del.Ver. | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010194 | MN -10 | 12:36556 |
| **SIA-** | | | | |
| 381/ 3 | Schweizerischer Ingenieur- und Architekten-Verein, Zurich | | ND -34B | 12:37724 |
| **SJF-BERETNING-** | | | | |
| 27 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752372 | MN -95 | 12:37149 |
| **SL-** | | | | |
| 1270.84918 | Danish Maritime Institute, Library, Hjortekaervej 99, DK-2800 Lyngby | | ND -60 | 12:36743 |
| **SLAC-PUB-** | | | | |
| 3928 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010843 | MN -34D | 12:38145 |
| 4178 | NTIS, PC A02; 3 | DE87009457 | MN -28 | 12:37554 |
| 4209 | NTIS, PC A02; 3 | DE87009455 | MN -28 | 12:37555 |
| 4217 | NTIS, PC A02; 3 | DE87009454 | MN -28 | 12:37556 |
| 4221 | NTIS, PC A02; 3 | DE87009453 | MN -28 | 12:37557 |
| 4251 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87010542 | MN -34D | 12:38223 |
| 4257 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010463 | MN -34D | 12:38309 |
| 4259 | NTIS, PC A02; 3 | DE87010543 | MN -34D | 12:38310 |
| 4287 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87010547 | MN -34D | 12:38146 |
| 4300 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87009893 | MN -34D | 12:38147 |
| 4312 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011591 | MN -34D | 12:38148 |
| 4313 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011592 | MN -34D | 12:38149 |
| 4315 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010313 | MN -34D | 12:38196 |
| 4316 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010312 | MN -34D | 12:38224 |
| 4323 | NTIS, PC A02; 3 | DE87011593 | MN -34D | 12:38197 |
| **SMUD-PV-** | | | | |
| 2 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011266 | MN -63 | 12:36649 |
| **SNIAS-** | | | | |
| 59-CA/ CG | NTIS, PC A03/MF A01 | | | 12:36637 |
| **SRC-TR-** | | | | |
| 80-579 | *See* PB-87-169488/XAB | | | 12:37991 |
| 81-521 | *See* PB-87-174629/XAB | | | 12:37633 |
| **STAN-CS-** | | | | |
| 86-1136 | *See* AD-A-179407/2/XAB | | | 12:38404 |
| **STEV-** | | | | |
| 1986-3 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752397 | MN -98 | 12:36987 |

| Report Number | Availability Source | File Number | Distribution Category | Abstract Number |
|---|---|---|---|---|
| **STEV-BF-** | | | | |
| 86-10 | NTIS (US Sales Only), PC A11/MF A01; 1 | DE87752396 | MN -109 | 12:36277 |
| 87-4 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752401 | MN -61A | 12:36602 |
| **STEV-BMF-** | | | | |
| 87-1 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752398 | MN -97 | 12:36766 |
| **STEV-EO-** | | | | |
| 87-2 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE87752402 | MN -61A | 12:36638 |
| 87-3 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752403 | MN -61A | 12:36639 |
| **STEV-FGT-** | | | | |
| 87-1 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752406 | MN -61 | 12:37705 |
| **STEV-TB-** | | | | |
| 87-4 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752407 | MN -61 | 12:37150 |
| **STEV-TORV-** | | | | |
| 87-5 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752400 | MN -101 | 12:36338 |
| 87-6 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752404 | MN -116 | 12:36344 |
| 87-7 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752405 | MN -116 | 12:36345 |
| **STEV-VIND-** | | | | |
| 87-5 | NTIS (US Sales Only), PC A07; 3 | DE87752399 | MN -97a | 12:36757 |
| **STF-** | | | | |
| 21A85024 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752499 | MN -11 | 12:37766 |
| 21A85102 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752498 | MN -121 | 12:36423 |
| **STI/E-TR-** | | | | |
| 860135 | *See* AD-A-179272/0/XAB | | | 12:37580 |
| **SUPRI-TR-** | | | | |
| 56 | *See* DOE/SF/11564-22 | E 1.99: DE87001247 | STD -122 | 12:36382 |
| 57 | *See* DOE/SF/11564-23 | E 1.99: DE87001248 | STD -122 | 12:36383 |
| 58 | *See* DOE/SF/11564-24 | E 1.99: DE87001249 | STD -122 | 12:36384 |
| **TKK-KO/ET-** | | | | |
| 16 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752375 | MN -4 | 12:37444 |
| 19 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752376 | MN -103 | 12:36363 |
| 20 | NTIS (US Sales Only), PC A02/MF A01; 1 | DE87752378 | MN -97d | 12:36758 |
| 21 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752377 | MN -38 | 12:37501 |
| **TKK-KO/LVI-** | | | | |
| B11 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752477 | MN -95d | 12:37082 |
| B12 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE87752478 | MN -95d | 12:37083 |
| C12 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752379 | MN -11 | 12:37084 |
| C19 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752380 | MN -11 | 12:37085 |
| C21 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752381 | MN -11 | 12:37086 |
| C22 | NTIS (US Sales Only), PC A07/MF A01; 1 | DE87752382 | MN -11 | 12:37087 |
| C23 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752383 | MN -11 | 12:37088 |
| C24 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752384 | MN -11 | 12:37089 |
| C25 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752387 | MN -11 | 12:37090 |
| C26 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752388 | MN -11 | 12:37091 |
| C28 | NTIS (US Sales Only), PC A06/MF A01; 1 | DE87752385 | MN -11 | 12:37092 |
| C36 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE87752479 | MN -11 | 12:37093 |
| C39 | NTIS (US Sales Only), PC A04/MF A01; 1 | DE87752386 | MN -11 | 12:37094 |
| **TR-** | | | | |
| 82-98/ EE-VOL-1 | *See* PB-87-177523/XAB | | | 12:36606 |
| 82-98/ EE-VOL-2 | *See* PB-87-177531/XAB | | | 12:36607 |
| 0086(6940-06) -12 | *See* AD-A-179136/7/XAB | | | 12:38081 |
| **TR-EL-** | | | | |
| 82-4/ 82-11-72 | NTIS, PC A02/MF A01 | TI87900645 | MN -11 | 12:37836 |
| **TTI-** | | | | |
| 2-8-80-283-2 | *See* PB-87-190567/XAB | | | 12:37184 |
| **TVA/ONRED/AWR-** | | | | |
| 87/ 6 | NTIS, PC A04/MF A01; 1 | DE87900851 | MN -11 | 12:38040 |
| 87/ 25 | NTIS, PC A03/MF A01; 1 | DE87900852 | MN -11 | 12:37846 |
| **TVA/ONRED/WRF-** | | | | |
| 85/ 1b | NTIS, PC A13/MF A01; 1 | DE87900883 | MN -11 | 12:37856 |
| **TVA/PUB-** | | | | |
| 87/ 18 | NTIS, PC A06/MF A01; 1 | DE87900884 | MN -13 | 12:37151 |
| **TWC-** | | | | |
| 014V-86-3143 | *See* ETSU-WN-5055 | | ND -60 | 12:36740 |
| **TWC-P-** | | | | |
| 8218 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36738 |
| **UAG-** | | | | |
| 95 | *See* PB-87-184198/XAB | | | 12:38067 |
| **UCID-** | | | | |
| 16986-87 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012313 | MN -123 | 12:36470 |
| 19080-86 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010846 | MN -38 | 12:37447 |
| 19348-Rev.1 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87012312 | MN -132 | 12:36438 |
| 20466 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87010707 | MN -78 | 12:36931 |
| 20475 | NTIS, PC A06/MF A01; 1 (GPO Dep.) | E 1.99: DE87010706 | MN -78 | 12:36932 |
| 20622-87-2 | NTIS, PC A08/MF A01; 1 (GPO Dep.) | E 1.99: DE87011547 | MN -25 | 12:37197 |
| 20676 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011906 | MN -25 | 12:37243 |
| 20682 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87011004 | MN -21 | 12:37486 |
| 20754 | NTIS, PC A04/MF A01; 1 | DE87011905 | MN -11 | 12:37852 |
| 21031 | NTIS, PC A09/MF A01; 1 (GPO Dep.) | E 1.99: DE87011695 | MN -11 | 12:37853 |
| 21073 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010849 | MN -38 | 12:37466 |
| 21075 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87011600 | MN -20f | 12:37518 |
| 21083 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010620 | MN -38 | 12:37467 |
| 21101 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011899 | MN -34 | 12:38302 |
| 21106 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87012309 | MN -13 | 12:38400 |

| *Report Number* | *Availability Source* | *File Number* | *Distribution Category* | *Abstract Number* |
|---|---|---|---|---|
| **UCLA-** | | | | |
| 34P278-61 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87012178 | MN -48 | 12:36640 |
| **UCLA/PPG-** | | | | |
| 1070 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87010296 | STD -20f | 12:38355 |
| **UCRL-** | | | | |
| 15873 | NTIS, PC A05/MF A01; 1 (GPO Dep.) | E 1.99: DE87011345 | MN -11 | 12:37828 |
| 15902 | NTIS, PC A07/MF A01; 1 (GPO Dep.) | E 1.99: DE87011329 | MN -11 | 12:37584 |
| 15916 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011348 | MN -11 | 12:37706 |
| 92353 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87008755 | MN -21 | 12:38383 |
| 92902 | NTIS, PC A02; 3 | DE87009587 | MN -34C | 12:38198 |
| 93569-Rev.1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87008483 | MN -21 | 12:38384 |
| 93796 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87008740 | MN -38 | 12:37487 |
| 94049 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009602 | MN -45 | 12:37585 |
| 94086 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009603 | MN -34 | 12:38356 |
| 94346-Rev.1 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009607 | MN -21 | 12:38385 |
| 94791 | NTIS, PC A02; 3 | DE87009947 | MN -37 | 12:37509 |
| 95561 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009850 | MN -41 | 12:38017 |
| 95798 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010878 | MN -4 | 12:36603 |
| 96021 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87009745 | MN -38 | 12:37468 |
| 96243 | NTIS, PC A02; 3 | DE87010813 | MN -34B | 12:37728 |
| 96314 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011557 | MN -22 | 12:36481 |
| 96407 | NTIS, PC A02; 3 | DE87011558 | MN -15 | 12:36572 |
| 96437 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87008843 | MN -38 | 12:37523 |
| 96443 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87008846 | MN -38 | 12:37502 |
| 96579 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010337 | MN -38 | 12:37488 |
| 96585 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | A 1.99: DE87010247 | MN -11 | 12:38048 |
| 96629 | NTIS, PC A02; 3 | DE87009747 | MN -38 | 12:37469 |
| 96643 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011562 | MN -25 | 12:37244 |
| 96644 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87010871 | MN -48 | 12:38007 |
| 96725 | NTIS, PC A03/MF A01; 1 (GPO Dep.) | E 1.99: DE87010811 | MN -34B | 12:38070 |
| 96763 | NTIS, PC A02; 3 | DE87010782 | MN -32 | 12:38104 |
| 96787 | NTIS, PC A02/MF A01 (GPO Dep.) | E 1.99: DE87011561 | MN -25 | 12:37245 |
| 96796 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87011879 | MN -4 | 12:37381 |
| **UCRL-Trans-** | | | | |
| 12178 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: DE87009118 | MN -25 | 12:37256 |
| **UFTP-** | | | | |
| 87-4 | *See* DOE/ER/40272-32 | A 1.99: DE87008766 | MN -34B | 12:38057 |
| 87-9 | *See* DOE/ER/40272-37 | E 1.99: DE87011205 | MN -34D | 12:38216 |
| 87-10 | *See* DOE/ER/40272-38 | E 1.99: DE87011206 | MN -34D | 12:38217 |
| **UIC-** | | | | |
| 87-14 | *See* ANL-HEP-CP-87-15 | E 1.99: DE87011482 | MN -34D | 12:38214 |
| **ULRF-** | | | | |
| 435/ CAR | *See* AD-A-179174/8/XAB | | | 12:38082 |
| **UNC/GJ-** | | | | |
| 34-TMC | *See* DOE/ID/12584-5 | E 1.99: DE87011230 | STD -70A | 12:37820 |
| **UNI-** | | | | |
| 3760 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87008414 | MN -80 | 12:36816 |
| 4065 | NTIS, PC A04/MF A01; 1 (GPO Dep.) | E 1.99: DE87008413 | MN -80 | 12:36817 |
| **UNI-SA-** | | | | |
| 166 | NTIS MF A01; 2 (GPO Dep.) | E 1.99: DE87007840 | MN -80 | 12:36810 |
| **USAFOEHL-** | | | | |
| 87-022EQ0156CHH | *See* AD-A-179348/8/XAB | | | 12:36957 |
| **USAFSAM-JA-** | | | | |
| 86-43 | *See* AD-A-179275/3/XAB | | | 12:38012 |
| **UT-CMSE-** | | | | |
| 87-02 | *See* AD-A-179289/4/XAB | | | 12:37200 |
| **UVA-** | | | | |
| 525657/ EE87/ 101 | *See* AD-A-179604/4/XAB | | | 12:37452 |
| 528253/ AM87/ 101 | *See* N-87-20860 | | | 12:38061 |
| **VPI-** | | | | |
| 86-29 | *See* CCMS-6-08 | | | 12:37329 |
| **VPI-VWRRC-Bull-** | | | | |
| 154 | *See* PB-87-176269/XAB | | | 12:37840 |
| 155 | *See* PB-87-176277/XAB | | | 12:37841 |
| **VTT-TIED-** | | | | |
| 649 | NTIS (US Sales Only), PC A05/MF A01; 1 | DE87752482 | MN -95d | 12:37095 |
| 669 | NTIS (US Sales Only), PC A03/MF A01; 1 | DE87752480 | MN -105 | 12:36335 |
| **VTT-TUTK-** | | | | |
| 455 | NTIS (US Sales Only), PC A08/MF A01; 1 | DE87752481 | MN -61D | 12:36278 |
| **Y-** | | | | |
| 2407 | *See* YR-2788-Vol.1 | | ND -60 | 12:36744 |
| 2407 | *See* YR-2788-Vol.2 | | ND -60 | 12:36745 |
| **Y/DS-** | | | | |
| 254 | NTIS, PC A02/MF A01; 1 (GPO Dep.) | E 1.99: DE87005738 | MN -2 | 12:36573 |
| **YR-** | | | | |
| 2788-Vol.1 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36744 |
| 2788-Vol.2 | British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ | | ND -60 | 12:36745 |

# FILE NUMBER CORRELATION

This correlation list is provided for those organizations where document storage is alphanumeric by report number and request may be received by file number. For other information about a document (abstract number, distribution category, availability, and price), please refer to the Report Number Index.

| *File No.* | *Report No.* |
|---|---|
| DE86001589 | DOE/MC/19403—1816 |
| DE87000233 | CONF-870405—10 |
| DE87001040 | DOE/LC/11067—2235-Vol.2 |
| DE87001165 | SERI/TR—211-3052 |
| DE87001167 | SERI/STR—255-3040 |
| DE87001168 | SERI/STR—211-3127 |
| DE87001170 | SERI/SP—231-2878 |
| DE87001172 | SERI/STR—211-3149 |
| DE87001173 | SERI/STR—211-3148 |
| DE87001217 | DOE/BC—87/2/SP |
| DE87001219 | DOE/BC—86/6/SP |
| DE87001244 | DOE/BC/10847—5 |
| DE87001245 | DOE/BC/10846—5 |
| DE87001247 | DOE/SF/11564—22 |
| DE87001248 | DOE/SF/11564—23 |
| DE87001249 | DOE/SF/11564—24 |
| DE87001250 | DOE/BC/10841—5 |
| DE87003456 | CONF-870862—3 |
| DE87004259 | CONF-870210—1 |
| DE87004743 | CONF-861102—35 |
| DE87004838 | CONF-8610280—1 |
| DE87004853 | CONF-861063—7 |
| DE87004908 | DOE/CS/50058—T1 |
| DE87005536 | SAND—87-0180C |
| DE87005570 | DOE/ER—0146/2 |
| DE87005684 | CONF-870601—9 |
| DE87005738 | Y/DS—254 |
| DE87005849 | SAND—86-2774C |
| DE87005870 | SAND—87-0094C |
| DE87005875 | SAND—87-0273C |
| DE87006129 | SAND—87-0403C |
| DE87006147 | LBL—22718 |
| DE87006307 | LA—10625-MS-Rev. |
| DE87006390 | DP-MS—86-149 |
| DE87006477 | DOE/MC/21097—2338 |
| DE87006489 | DOE/MC/21131—2350 |
| DE87006657 | SAND—86-2447C |
| DE87006944 | LBL—22747 |
| DE87006986 | CONF-870102—13-FP |
| DE87007009 | CONF-860856—13 |
| DE87007148 | DOE/CE/63503—T1 |
| DE87007149 | DOE/CE/63503—T2 |
| DE87007150 | DOE/CE/63503—T3-Pt.1 |
| DE87007151 | DOE/CE/63503—T3-Pt.2 |
| DE87007152 | DOE/CE/63503—T3-Pt.3 |
| DE87007376 | DOE/ER/05126—307 |
| DE87007456 | LA-UR—87-1000 |
| DE87007689 | DOE/PC/70765—9 |
| DE87007840 | UNI-SA—166 |
| DE87007864 | SAND—87-0638C |
| DE87007926 | CONF-870292—1-Vugraphs |
| DE87008149 | DOE/S—0058 |
| DE87008183 | RFP-Trans—465 |
| DE87008196 | BNL—39508 |
| DE87008198 | BNL—39456 |
| DE87008201 | BNL—39507 |
| DE87008203 | BNL—39457 |
| DE87008308 | DOE/PC/73226—4 |
| DE87008413 | UNI—4065 |
| DE87008414 | UNI—3760 |
| DE87008446 | BNL—39509 |
| DE87008483 | UCRL—93569-Rev.1 |
| DE87008491 | DOE/ER/40150—22 |
| DE87008509 | SAND—87-0683C |
| DE87008510 | SAND—87-0682C |
| DE87008659 | DOE/ER/40150—10 |
| DE87008662 | DOE/ER/40150—12 |
| DE87008664 | DOE/ER/40150—29 |
| DE87008666 | DOE/ER/40150—24 |
| DE87008667 | DOE/ER/40150—25 |
| DE87008671 | DOE/ER/40150—13 |
| DE87008672 | DOE/ER/40150—15 |
| DE87008673 | DOE/ER/40150—27 |
| DE87008674 | DOE/ER/40150—8 |
| DE87008675 | DOE/ER/40150—23 |
| DE87008676 | DOE/ER/40150—1 |
| DE87008677 | DOE/ER/40150—9 |
| DE87008678 | DOE/ER/40150—7 |
| DE87008679 | DOE/ER/40150—2 |
| DE87008740 | UCRL—93796 |
| DE87008755 | UCRL—92353 |
| DE87008766 | DOE/ER/40272—32 |
| DE87008775 | CONF-870178—1 |
| DE87008790 | CONF-8703140—1-Vugraphs |
| DE87008797 | CONF-870862—5 |
| DE87008799 | CONF-870498—3 |
| DE87008803 | CONF-8703144—1 |
| DE87008804 | CONF-8703141—1-Summ. |
| DE87008805 | CONF-870802—5 |
| DE87008843 | UCRL—96437 |
| DE87008846 | UCRL—96443 |
| DE87009031 | FNAL-TM—1444 |
| DE87009060 | SAND—86-2750C |
| DE87009064 | DOE/PC/90275—T4 |
| DE87009076 | DOE/CE/26526—T1 |
| DE87009118 | UCRL-Trans—12178 |
| DE87009119 | CONF-870570—9 |
| DE87009120 | CONF-8705132—1 |
| DE87009125 | CONF-8705133—1-Vugraphs |
| DE87009132 | CONF-870862—6 |
| DE87009133 | CONF-870862—1 |
| DE87009164 | LBL—23136 |
| DE87009196 | MLM—3436(OP) |
| DE87009197 | MLM—3428(OP) |
| DE87009289 | SAND—86-2828C |
| DE87009290 | SAND—87-1128C |
| DE87009295 | SAND—86-1606C |
| DE87009296 | SAND—87-0804C |
| DE87009301 | GA-A—18775 |
| DE87009319 | DOE/CE/40539—02 |
| DE87009321 | DOE/CE/40539—04 |
| DE87009322 | DOE/CE/40539—05 |
| DE87009323 | DOE/CE/40539—06 |
| DE87009332 | CONF-8705113—1 |
| DE87009345 | EGG-M—00387 |
| DE87009351 | SAND—86-0977 |
| DE87009398 | EGG-M—29786 |
| DE87009448 | DOE/ER/45135—17 |
| DE87009453 | SLAC-PUB—4221 |
| DE87009454 | SLAC-PUB—4217 |
| DE87009455 | SLAC-PUB—4209 |
| DE87009457 | SLAC-PUB—4178 |
| DE87009465 | LA—10929-MS |
| DE87009499 | SAND—86-2883C |
| DE87009501 | SAND—86-2884C |
| DE87009502 | SAND—87-1224C |
| DE87009503 | SAND—87-7115C |
| DE87009548 | LBL—22189 |
| DE87009550 | LBL—22193 |
| DE87009559 | DOE/JPL/956985—1 |
| DE87009587 | UCRL—92902 |
| DE87009602 | UCRL—94049 |
| DE87009603 | UCRL—94086 |
| DE87009607 | UCRL—94346-Rev.1 |
| DE87009665 | CONF-870523—3 |
| DE87009678 | CONF-8705116—3 |
| DE87009680 | CONF-8705116—2 |
| DE87009681 | CONF-870804—5 |
| DE87009686 | CONF-870405—4-Vugraphs |
| DE87009711 | DOE/ER/40048—192 |
| DE87009745 | UCRL—96021 |
| DE87009747 | UCRL—96629 |
| DE87009787 | PNL—6036 |
| DE87009802 | DOE/ER/13465—2 |
| DE87009812 | CONF-870752—1-Ext.Abst. |
| DE87009818 | CONF-870877—1 |
| DE87009822 | CONF-870873—2 |
| DE87009823 | CONF-8705108—1 |
| DE87009825 | CONF-870873—3 |
| DE87009850 | UCRL—95561 |
| DE87009866 | DOE/SF/11653—T12 |
| DE87009893 | SLAC-PUB—4300 |
| DE87009947 | UCRL—94791 |
| DE87009956 | DOE/OR/21495—T1 |
| DE87009966 | HEDL-SA—3491 |
| DE87009967 | HEDL-SA—3629 |
| DE87009968 | HEDL-SA—3673-FP |
| DE87009972 | HEDL-SA—3349 |
| DE87010005 | DOE/ET/51013—206 |
| DE87010022 | CONF-8705117—1 |
| DE87010033 | SAND—86-1457C |
| DE87010034 | SAND—87-1306C |
| DE87010041 | BNL—39724 |
| DE87010042 | BNL—39663 |
| DE87010045 | BNL—39747 |
| DE87010050 | BNL—39657 |
| DE87010053 | BNL—39593 |
| DE87010056 | BNL—39605 |
| DE87010062 | BNL—39697 |
| DE87010069 | BNL—39665 |
| DE87010071 | BNL—39661 |
| DE87010082 | FNAL/C—87/71 |
| DE87010105 | LA-UR—87-1531 |
| DE87010106 | LA-UR—87-1535 |
| DE87010108 | LA-UR—87-1544 |
| DE87010110 | LA-UR—87-1561 |
| DE87010126 | LA-UR—87-1714 |
| DE87010129 | LA-UR—87-1739 |
| DE87010131 | LA-UR—87-1748 |
| DE87010164 | DP-MS—86-151 |
| DE87010194 | SI—85-4-23-Del.Ver. |
| DE87010215 | LA—10992-ENV |
| DE87010226 | K/TS—11-869 |
| DE87010235 | DOE/ER/02271—110 |
| DE87010239 | BMI/ONWI—636 |
| DE87010245 | BMI/ONWI—638 |
| DE87010247 | UCRL—96585 |
| DE87010248 | DOE/ER/40068—3 |
| DE87010260 | LBL—23122 |
| DE87010263 | LBL—23299 |
| DE87010279 | LBL—23352 |
| DE87010285 | LBL—20896 |
| DE87010296 | UCLA/PPG—1070 |
| DE87010304 | DOE/ER/10638—7 |

| File No. | Report No. |
|---|---|
| DE87010312 | SLAC-PUB—4316 |
| DE87010313 | SLAC-PUB—4315 |
| DE87010337 | UCRL—96579 |
| DE87010345 | DOE/BP—707 |
| DE87010372 | CONF-870501—4 |
| DE87010373 | CONF-870629—3 |
| DE87010375 | CONF-870501—3 |
| DE87010390 | CONF-870570—12 |
| DE87010393 | CONF-870629—2 |
| DE87010394 | CONF-870757—2 |
| DE87010401 | CONF-870757—1 |
| DE87010402 | CONF-870629—1 |
| DE87010406 | DOE/ER/75173—1 |
| DE87010410 | HEDL-SA—3188 |
| DE87010411 | HEDL-SA—3359 |
| DE87010412 | HEDL-SA—3418 |
| DE87010424 | DOE/PC/91272—T11 |
| DE87010431 | SAND—87-0636C |
| DE87010435 | SAND—86-2823C |
| DE87010448 | BNL—39723 |
| DE87010463 | SLAC-PUB—4257 |
| DE87010477 | SAND—87-0146C |
| DE87010494 | SAND—86-2869C |
| DE87010496 | SAND—87-1091C |
| DE87010501 | DOE/SF/15303—2 |
| DE87010502 | DOE/SF/15303—1 |
| DE87010513 | SAND—87-1402C |
| DE87010522 | SAND—85-2317-Rev. |
| DE87010529 | SAND—86-7133 |
| DE87010531 | SAND—87-0184 |
| DE87010532 | SAND—87-0501 |
| DE87010542 | SLAC-PUB—4251 |
| DE87010543 | SLAC-PUB—4259 |
| DE87010547 | SLAC-PUB—4287 |
| DE87010582 | ORNL/TM—10421 |
| DE87010590 | CONF-8706124—1 |
| DE87010597 | CONF-870804—10 |
| DE87010599 | CONF-8704112—6 |
| DE87010601 | CONF-870801—1 |
| DE87010604 | CONF-870174—1 |
| DE87010605 | CONF-8706119—1 |
| DE87010611 | NUREG/CR—4674-Vol.4 |
| DE87010614 | PNL—5881 |
| DE87010618 | DOE/NE/32117—H1 |
| DE87010620 | UCID—21083 |
| DE87010623 | SAND—83-0768 |
| DE87010626 | PPPL—2368 |
| DE87010627 | PPPL—2400 |
| DE87010628 | PPPL—2402 |
| DE87010629 | PPPL—2419 |
| DE87010630 | PPPL—2420 |
| DE87010631 | PPPL—2421 |
| DE87010632 | PPPL—2422 |
| DE87010633 | PPPL—2424 |
| DE87010634 | PPPL—2425 |
| DE87010635 | PPPL—2427 |
| DE87010636 | PPPL—2431 |
| DE87010643 | DOE/EIS—0132-D-Vol.1 |
| DE87010646 | CONF-861204—9 |
| DE87010651 | GA-A—18842 |
| DE87010657 | DOE/CE/24444—T1 |
| DE87010679 | DOE/NE/37959—2 |
| DE87010680 | DOE/NE/37959—3 |
| DE87010682 | DOE/ER/40158—3 |
| DE87010688 | RHO-RE-SA—182 |
| DE87010690 | DOE/FE—0083 |
| DE87010696 | GEND—061 |
| DE87010704 | DOE/PC/90519—T2 |
| DE87010705 | DOE/PC/80016—T3 |
| DE87010706 | UCID—20475 |
| DE87010707 | UCID—20466 |
| DE87010708 | DOE/PC/80518—T7 |
| DE87010726 | HEDL-SA—3530 |
| DE87010735 | SAND—87-1114C |
| DE87010738 | SAND—87-0283C |
| DE87010739 | SAND—87-0404C |
| DE87010740 | LBL—23312 |
| DE87010741 | SAND—87-0071C |
| DE87010748 | DOE/ER/13546—1 |
| DE87010752 | DOE/PC/90909—T3 |
| DE87010753 | BNL—39805 |
| DE87010760 | BNL—39765 |
| DE87010763 | BNL—39822 |
| DE87010764 | DOE/ET/53088—213 |
| DE87010765 | DOE/ET/53088—254 |
| DE87010766 | DOE/ET/53088—276 |
| DE87010767 | DOE/ET/53088—277 |
| DE87010768 | DOE/ET/53088—279 |
| DE87010774 | DOE/PC/90538—3 |
| DE87010779 | SAND—86-2670C |
| DE87010782 | UCRL—96763 |
| DE87010785 | DOE/CE/63498—T1 |
| DE87010788 | DOE/ET/53088—275 |
| DE87010790 | BNL—39866 |
| DE87010794 | DOE/ER/40107—T3 |
| DE87010811 | UCRL—96725 |
| DE87010813 | UCRL—96243 |
| DE87010815 | DOE/FE—0087 |
| DE87010835 | LA—10989-T |
| DE87010843 | SLAC-PUB—3928 |
| DE87010846 | UCID—19080-86 |
| DE87010849 | UCID—21073 |
| DE87010850 | LBL—23508 |
| DE87010855 | DOE/PC/80537—T5 |
| DE87010856 | DOE/PC/80537—T6 |
| DE87010858 | DOE/PC/80537—T4 |
| DE87010863 | DOE/MC/19210—2357 |
| DE87010871 | UCRL—96644 |
| DE87010878 | UCRL—95798 |
| DE87010884 | KMSF-U—1566 |
| DE87010887 | CONF-8704155—1 |
| DE87010888 | CONF-870811—2 |
| DE87010889 | CONF-870759—1 |
| DE87010892 | CONF-8706113—2 |
| DE87010894 | CONF-8706142—1 |
| DE87010898 | CONF-8704145—1 |
| DE87010904 | CONF-860883—2 |
| DE87010906 | CONF-870763—1 |
| DE87010914 | DOE/ER/40200—091 |
| DE87010915 | DOE/ER/40200—092 |
| DE87010921 | IS-T—1276 |
| DE87010927 | IS-T—1281 |
| DE87010932 | IS-T—1279 |
| DE87010939 | FNAL/Pub—87/77-A |
| DE87010942 | EGG—2508 |
| DE87010943 | DOE/RA/23209—1 |
| DE87010960 | DOE/ER/52118—2 |
| DE87010969 | DOE/ER/13449—T8 |
| DE87010972 | DOE/NBM—7010972 |
| DE87010976 | LBL—23442 |
| DE87010985 | LBL—23427 |
| DE87010992 | SAND—86-0236 |
| DE87010995 | FNAL-TM—1463 |
| DE87011000 | FNAL-TM—1458 |
| DE87011001 | FNAL-TM—1457 |
| DE87011004 | UCID—20682 |
| DE87011006 | BMI/ONWI—640 |
| DE87011015 | DOE/ER/25014—1 |
| DE87011018 | DOE/ER/10807—03 |
| DE87011028 | LBL—22477 |
| DE87011033 | DOE/ET/51013—218 |
| DE87011036 | DOE/ET/51013—221 |
| DE87011039 | DOE/ID/12583—2 |
| DE87011044 | DOE/ER/52127—12 |
| DE87011047 | DOE/PC/70753—T11 |
| DE87011049 | RFP—4128 |
| DE87011050 | RFP—4124 |
| DE87011053 | RFP—4105 |
| DE87011054 | RFP—4106 |
| DE87011056 | RFP—4119 |
| DE87011059 | SAND—87-0622C |
| DE87011064 | SAND—87-0765C |
| DE87011066 | LA-UR—87-1673 |
| DE87011067 | FNAL/C—87/82 |
| DE87011076 | DOE/ER/13532—1 |
| DE87011081 | DOE/ER/40048—20-N7 |
| DE87011082 | DOE/ER/40048—19-N7 |
| DE87011084 | DOE/PC/80525—T7 |
| DE87011087 | DOE/ER/06042—7 |
| DE87011090 | LBL—23259 |
| DE87011091 | LBL—20545 |
| DE87011096 | LBL—23532 |
| DE87011097 | LBL—23533 |
| DE87011100 | LBL—23530 |
| DE87011103 | LBL—23452 |
| DE87011104 | LBL—22476 |
| DE87011107 | PNL—5979 |
| DE87011108 | PNL—6148 |
| DE87011111 | CONF-870659—2 |
| DE87011113 | CONF-870401—3-Abst. |
| DE87011114 | CONF-870764—1 |
| DE87011116 | CONF-8704151—1 |
| DE87011129 | ANL/MCT—87-1 |
| DE87011135 | LA-tr—87-13 |
| DE87011138 | PNL-SA—14426 |
| DE87011145 | PNL-SA—14744 |
| DE87011146 | PNL-SA—14768 |
| DE87011148 | PNL-SA—14377 |
| DE87011152 | PNL-SA—14400 |
| DE87011153 | PNL-SA—14315 |
| DE87011155 | PNL-SA—14767 |
| DE87011156 | PNL-SA—14190 |
| DE87011166 | DOE/BP/18945—T7 |
| DE87011175 | DP-MS—86-155 |
| DE87011179 | DP-MS—87-37 |
| DE87011180 | DP-MS—87-55 |
| DE87011183 | DP-MS—87-49 |
| DE87011185 | PNL-SA—14276 |
| DE87011186 | PNL-SA—14499 |
| DE87011188 | DOE/EIA—M021 |
| DE87011190 | DOE/ER/04073—20 |
| DE87011197 | DOE/ER/13327—2 |
| DE87011198 | DOE/PC/70777—T2 |
| DE87011199 | DOE/ET/33075—T1 |
| DE87011202 | DOE/CH/10235—2 |
| DE87011205 | DOE/ER/40272—37 |
| DE87011206 | DOE/ER/40272—38 |
| DE87011207 | DOE/ER/05096—26 |
| DE87011208 | CONF-8706151—1-Draft |
| DE87011211 | LBL—23342 |
| DE87011213 | LBL—23381 |
| DE87011216 | LBL—22991 |
| DE87011217 | DOE/ER/40073—T2 |
| DE87011218 | DOE/PC/90514—T3 |
| DE87011219 | DP-MS—86-138 |
| DE87011220 | DPST—85-704 |
| DE87011223 | LBL—23462 |
| DE87011224 | LBL—23477 |
| DE87011228 | DP-MS—87-1 |
| DE87011230 | DOE/ID/12584—5 |
| DE87011231 | PNL—6176 |
| DE87011235 | ANL/CNSV-TM—185 |
| DE87011236 | ANL—87-2 |
| DE87011237 | ANL/CNSV-TM—184 |
| DE87011239 | DPST—85-953 |
| DE87011240 | DPST—85-856 |
| DE87011242 | DP-MS—87-10 |
| DE87011243 | DP-MS—87-62 |
| DE87011244 | DP-MS—87-9 |
| DE87011251 | DP-MS—86-164 |
| DE87011252 | DP-MS—87-51 |
| DE87011253 | DP-MS—86-8 |
| DE87011254 | IS-T—1292 |
| DE87011255 | IS-T—1293 |
| DE87011256 | IS-T—1294 |
| DE87011263 | DOE/PC/70812—11 |
| DE87011264 | DOE/PC/90961—T3 |
| DE87011265 | DOE/SF/15774—T2 |
| DE87011266 | SMUD-PV—2 |
| DE87011268 | DOE/PC/70786—T9 |
| DE87011272 | PNL/SRP—6253 |
| DE87011274 | DOE/CE/40736—T1 |
| DE87011291 | BNL—39830 |
| DE87011300 | BNL—39876 |
| DE87011301 | BNL—35667 |
| DE87011304 | BNL—39905 |
| DE87011313 | SAND—87-1654C |
| DE87011317 | SAND—87-0641C |
| DE87011320 | SAND—87-1632C |
| DE87011329 | UCRL—15902 |
| DE87011330 | LA-UR—87-2252 |
| DE87011335 | DOE/CE/90001—1 |
| DE87011336 | PNL-SA—14022 |
| DE87011337 | PNL-SA—14497 |
| DE87011340 | DOE/PC/90504—T3 |
| DE87011341 | DOE/ER/13163—14 |
| DE87011342 | DOE/PC/80913—7 |
| DE87011345 | UCRL—15873 |
| DE87011348 | UCRL—15916 |
| DE87011353 | CONF-8611165—1 |
| DE87011357 | CONF-861076—7 |
| DE87011383 | CONF-870804—16 |
| DE87011385 | CONF-870804—17 |
| DE87011386 | CONF-870804—18 |
| DE87011388 | CONF-870804—14 |

| File No. | Report No. |
|---|---|
| DE87011391 | CONF-870711—5 |
| DE87011396 | CONF-870802—8 |
| DE87011397 | CONF-870816—22 |
| DE87011402 | CONF-870804—13 |
| DE87011403 | CONF-860914—34 |
| DE87011405 | ANL-HEP-CP—87-31 |
| DE87011412 | CONF-870497—2 |
| DE87011413 | CONF-870498—8 |
| DE87011415 | CONF-8704123—2 |
| DE87011416 | CONF-870438—27 |
| DE87011419 | CONF-870540—2 |
| DE87011420 | CONF-8704163—1 |
| DE87011422 | CONF-870540—1 |
| DE87011424 | CONF-870541—2 |
| DE87011431 | CONF-870564—1 |
| DE87011432 | CONF-8705103—6 |
| DE87011433 | CONF-870501—6 |
| DE87011442 | CONF-870666—1 |
| DE87011445 | CONF-870661—7-Vugraphs |
| DE87011447 | CONF-870664—2 |
| DE87011450 | CONF-8705103—7 |
| DE87011455 | CONF-870588—2 |
| DE87011469 | CONF-870812—20 |
| DE87011476 | CONF-870142—13 |
| DE87011477 | CONF-870137—2 |
| DE87011478 | CONF-870172—2 |
| DE87011479 | CONF-870172—3 |
| DE87011481 | CONF-870172—4 |
| DE87011482 | ANL-HEP-CP—87-15 |
| DE87011483 | CONF-870142—14 |
| DE87011484 | ANL-HEP-CP—87-45 |
| DE87011487 | CONF-870142—15 |
| DE87011490 | CONF-870297—1 |
| DE87011496 | CONF-870388—11 |
| DE87011511 | CONF-8703148—1 |
| DE87011515 | CONF-870314—11 |
| DE87011518 | CONF-870306—61 |
| DE87011523 | CONF-870422—5 |
| DE87011525 | CONF-870438—28 |
| DE87011526 | CONF-870410—33 |
| DE87011527 | CONF-870410—31 |
| DE87011537 | CONF-870388—12 |
| DE87011540 | CONF-870366—1 |
| DE87011541 | ANL-HEP-CP—87-49 |
| DE87011547 | UCID—20622-87-2 |
| DE87011557 | UCRL—96314 |
| DE87011558 | UCRL—96407 |
| DE87011561 | UCRL—96787 |
| DE87011562 | UCRL—96643 |
| DE87011576 | SAND—85-7100 |
| DE87011578 | SAND—86-2874 |
| DE87011582 | SAND—87-0393 |
| DE87011585 | SAND—87-0178 |
| DE87011586 | SAND—87-0115 |
| DE87011591 | SLAC-PUB—4312 |
| DE87011592 | SLAC-PUB—4313 |
| DE87011593 | SLAC-PUB—4323 |
| DE87011598 | HEDL-TME—85-22 |
| DE87011600 | UCID—21075 |
| DE87011602 | DOE/SF/00098—T12 |
| DE87011603 | RFP-ENV—86 |
| DE87011605 | DOE/NASA/17088—5 |
| DE87011606 | SAND—86-2165 |
| DE87011607 | SAND—86-7036-Vol.1 |
| DE87011608 | SAND—85-2568 |
| DE87011609 | SAND—86-0587 |
| DE87011611 | SAND—87-0176 |
| DE87011615 | DOE/DP—0043 |
| DE87011616 | EPRI-AP—5221 |
| DE87011621 | DOE/ER/03130—262 |
| DE87011626 | DOE/PC/70780—T7 |
| DE87011629 | PNL—5751 |
| DE87011630 | DOE/ID/12524—T2 |
| DE87011637 | SAND—87-0741C |
| DE87011642 | CONF-8706152—1 |
| DE87011661 | DOE/ER/13295—T1 |
| DE87011667 | CONF-870802—9 |
| DE87011680 | PNL-SA—14225 |
| DE87011682 | DOE/SF/15799—T12 |
| DE87011683 | DOE/PC/90529—2 |
| DE87011684 | CONF-8706125—3-Draft |
| DE87011691 | DOE/PC/60038—T6 |
| DE87011693 | DOE/DP—0044 |
| DE87011694 | BMI/ONWI—643 |
| DE87011695 | UCID—21031 |
| DE87011696 | SAND—87-8008 |
| DE87011697 | PNL—5953 |
| DE87011698 | PNL—6162 |
| DE87011700 | DOE/EA—0254 |
| DE87011701 | CONF-870233—2 |
| DE87011703 | DOE/ID—10150 |
| DE87011709 | DOE/ER/45280—1 |
| DE87011712 | DOE/EIA—M023 |
| DE87011718 | SAND—87-0922C |
| DE87011733 | LA-UR—87-2198 |
| DE87011737 | LA-UR—87-2160 |
| DE87011743 | LA-UR—87-2134 |
| DE87011749 | LA-UR—87-2119 |
| DE87011751 | LA-UR—87-2117 |
| DE87011752 | LA-UR—87-2116 |
| DE87011755 | LA-UR—87-2107 |
| DE87011758 | CONF-861288—1 |
| DE87011759 | CONF-851123—12 |
| DE87011781 | LA-UR—87-1964 |
| DE87011783 | LA-UR—87-1952 |
| DE87011799 | DOE/NE/44139—20 |
| DE87011800 | DOE/NE/44139—27 |
| DE87011801 | K/SUB—85-22224/5 |
| DE87011802 | K/SUB—85-22224/3 |
| DE87011805 | CONF-860826—14 |
| DE87011811 | CONF-860340—17 |
| DE87011812 | CONF-8609178—1 |
| DE87011813 | CONF-851047—2 |
| DE87011816 | CONF-8006116—3 |
| DE87011817 | CONF-870212—3 |
| DE87011818 | CONF-860801—1 |
| DE87011819 | CONF-861131—3 |
| DE87011821 | CONF-861131—4 |
| DE87011829 | DOE/ER/45163—10 |
| DE87011831 | DOE/PC/70809—T14 |
| DE87011837 | DOE/ER/60381—2 |
| DE87011840 | MLM—3442(OP) |
| DE87011841 | LBL—23512 |
| DE87011848 | DOE/FE/60177—2365 |
| DE87011855 | SAND—87-0977C |
| DE87011858 | SAND—87-0947C |
| DE87011859 | SAND—86-2986C |
| DE87011860 | SAND—87-0002C |
| DE87011861 | SAND—87-0800C |
| DE87011866 | SAND—87-1038C |
| DE87011867 | SAND—87-1022C |
| DE87011868 | DOE/ER/10699—T6 |
| DE87011869 | DOE/ER/03130—T13 |
| DE87011872 | DOE/NE/44139—33 |
| DE87011879 | UCRL—96796 |
| DE87011889 | ORNL/TM—10474 |
| DE87011891 | DOE/EIA—0482 |
| DE87011892 | DOE/EIA—0035(87/03) |
| DE87011897 | BNL—52071 |
| DE87011898 | ANL/ES—150 |
| DE87011899 | UCID—21101 |
| DE87011905 | UCID—20754 |
| DE87011906 | UCID—20676 |
| DE87011907 | SAND—86-0173 |
| DE87011910 | DOE/BP—63585-1 |
| DE87011911 | DOE/BP—847 |
| DE87011914 | LBL—23570 |
| DE87011926 | DOE/ER/03416—48 |
| DE87011932 | CONF-870763—2 |
| DE87011945 | DOE/FE—0084-1 |
| DE87011948 | ORNL/TM—10403 |
| DE87011949 | ORNL/TM—10402 |
| DE87011952 | ORNL/TM—10377 |
| DE87011953 | ORNL/TM—10359 |
| DE87011954 | ORNL/TM—10338 |
| DE87011955 | ORNL/TM—10309 |
| DE87011957 | ORNL/TM—10289 |
| DE87011959 | ORNL/TM—10219 |
| DE87011959 | ORNL/TM—10206/P1 |
| DE87011961 | ORNL/TM—10112 |
| DE87011962 | ORNL—6405 |
| DE87011963 | ORNL—6397 |
| DE87011964 | ORNL—6380 |
| DE87011965 | ORNL—6369 |
| DE87011967 | ES/ESH—2 |
| DE87011968 | DOE/HWP—25 |
| DE87011970 | ORNL/TM—9821 |
| DE87011971 | ORNL/TM—9681 |
| DE87011973 | ORNL/ESH—1/V23 |
| DE87011976 | ORNL/Sub—85-21674/1 |
| DE87011977 | ORNL/CON—229 |
| DE87011978 | ORNL/CON—196 |
| DE87011979 | DOE/ER/10604—7 |
| DE87011981 | DOE/PC/90502—3 |
| DE87011983 | ORNL/Sub—85-27488/01 |
| DE87011988 | PNL-SA—14605 |
| DE87011994 | PNL-SA—14976 |
| DE87011995 | PNL-SA—14624 |
| DE87011996 | PNL—6189 |
| DE87011997 | DOE/EA—0322 |
| DE87011998 | ANL—87-18 |
| DE87012000 | DOE/MA—0297-1 |
| DE87012025 | PNL-SA—14244 |
| DE87012031 | LBL—23579 |
| DE87012032 | LBL—23536 |
| DE87012038 | DOE/ID—10171 |
| DE87012039 | DOE/FE/60177—2367 |
| DE87012040 | DOE/FE/60177—2366 |
| DE87012041 | DOE/FE/60177—2368 |
| DE87012047 | DOE/PC/80016—T4 |
| DE87012048 | DOE/MC/23249—2360 |
| DE87012050 | LA—10874 |
| DE87012055 | DOE/ID/12170—2 |
| DE87012058 | LBL—23578 |
| DE87012064 | DOE/ER/03130—630 |
| DE87012065 | DOE/ER/03130—264 |
| DE87012066 | DOE/ER/03130—35 |
| DE87012067 | BNL—52052 |
| DE87012069 | MHSMP—87-18 |
| DE87012070 | PNL—6251 |
| DE87012074 | DOE/ER/02570—11 |
| DE87012077 | DOE/ER/45160—1 |
| DE87012079 | DOE/PC/80011—T1 |
| DE87012087 | DOE/PC/90507—T3 |
| DE87012091 | DOE/PC/80908—4 |
| DE87012093 | LBL—23307 |
| DE87012096 | DOE/PC/81210—T15 |
| DE87012098 | DOE/PC/60015—44 |
| DE87012099 | DOE/ER/03591—1 |
| DE87012106 | LA—11059-MS |
| DE87012108 | DOE/PC/90536—T3 |
| DE87012123 | BNL—39924 |
| DE87012137 | LBL—22992 |
| DE87012139 | DOE/CE/63492—T3 |
| DE87012147 | DOE/ER/45077—3 |
| DE87012148 | DOE/SR/00870—40 |
| DE87012153 | DOE/EV/05854—9 |
| DE87012178 | UCLA—34P278-61 |
| DE87012180 | DOE/EIA—0501 |
| DE87012182 | DOE/EIA—0380(87/04) |
| DE87012183 | DOE/FC/10627—2363 |
| DE87012198 | DOE/ER/13108—T4 |
| DE87012201 | DOE/PC/62700—T10 |
| DE87012203 | DOE/MA—0271 |
| DE87012204 | DOE/ER/04987—8 |
| DE87012299 | DOE/ER/12087—T4 |
| DE87012300 | RFP—4046 |
| DE87012303 | RFP—3987 |
| DE87012307 | BNL—52042 |
| DE87012309 | UCID—21106 |
| DE87012312 | UCID—19348-Rev.1 |
| DE87012313 | UCID—16986-87 |
| DE87012314 | SAND—87-0620 |
| DE87012320 | BMI/ONWI—647 |
| DE87012321 | BMI/ONWI—646 |
| DE87012325 | MLM—3441 |
| DE87012336 | DOE/CH—15-2 |
| DE87012337 | DOE/CH—15-1 |
| DE87012340 | SAND—87-0315 |
| DE87012343 | SAND—86-0929 |
| DE87012345 | SAND—84-7208 |
| DE87012363 | SAND—87-1702C |
| DE87012421 | DOE/ID/12560—4 |
| DE87012500 | PNL—6261 |
| DE87012503 | PNL—6208 |
| DE87012504 | SAND—86-2470 |
| DE87012505 | SAND—86-1266 |
| DE87012507 | SAND—85-0008 |
| DE87012509 | SAND—85-7208 |
| DE87012511 | SAND—87-1227 |
| DE87012514 | SAND—87-0706 |
| DE87012681 | DOE/FE/60177—2375 |
| DE87751771 | IFP—33-507 |
| DE87751772 | FRNC-TH—2377 |
| DE87751773 | CEA-CONF—8717 |

| File No. | Report No. |
|---|---|
| DE87751782 | EUR—9374 |
| DE87751790 | CEA-CONF—8619 |
| DE87751792 | EUR—9864 |
| DE87752299 | EUR—9955 |
| DE87752300 | EUR—9491 |
| DE87752310 | EUR—10285 |
| DE87752314 | IFP—34-367-1 |
| DE87752315 | IFP—34-367-2 |
| DE87752316 | ENV-MER—80-053 |
| DE87752317 | IFP—33-261 |
| DE87752318 | IFP—33-325 |
| DE87752319 | FRNC-TH—1996 |
| DE87752363 | DTH-LV-R—86-12 |
| DE87752364 | NEI-DK—19 |
| DE87752365 | NEI-DK—20 |
| DE87752366 | KC—86/01d |
| DE87752367 | NEI-DK—22 |
| DE87752368 | NEI-DK—23 |
| DE87752369 | NEI-DK—24 |
| DE87752370 | NEI-DK—25 |
| DE87752371 | NEI-DK—26 |
| DE87752372 | SJF-BERETNING—27 |
| DE87752375 | TKK-KO/ET—16 |
| DE87752376 | TKK-KO/ET—19 |
| DE87752377 | TKK-KO/ET—21 |
| DE87752378 | TKK-KO/ET—20 |
| DE87752379 | TKK-KO/LVI—C12 |
| DE87752380 | TKK-KO/LVI—C19 |
| DE87752381 | TKK-KO/LVI—C21 |
| DE87752382 | TKK-KO/LVI—C22 |
| DE87752383 | TKK-KO/LVI—C23 |
| DE87752384 | TKK-KO/LVI—C24 |
| DE87752385 | TKK-KO/LVI—C28 |
| DE87752386 | TKK-KO/LVI—C39 |
| DE87752387 | TKK-KO/LVI—C25 |
| DE87752388 | TKK-KO/LVI—C26 |
| DE87752391 | BFR-D—5-1986 |
| DE87752392 | BFR-R—38-1986 |
| DE87752393 | BFR-G—10-1986 |
| DE87752394 | BFR-R—43-1986 |
| DE87752395 | BFR-R—10-1986 |
| DE87752396 | STEV-BF—86-10 |
| DE87752397 | STEV—1986-3 |
| DE87752398 | STEV-BMF—87-1 |
| DE87752399 | STEV-VIND—87-5 |
| DE87752400 | STEV-TORV—87-5 |
| DE87752401 | STEV-BF—87-4 |
| DE87752402 | STEV-EO—87-2 |
| DE87752403 | STEV-EO—87-3 |
| DE87752404 | STEV-TORV—87-6 |
| DE87752405 | STEV-TORV—87-7 |
| DE87752406 | STEV-FGT—87-1 |
| DE87752407 | STEV-TB—87-4 |
| DE87752456 | NP—7752456 |
| DE87752457 | CONF-8508235— |
| DE87752458 | CONF-8704142—Summs. |
| DE87752459 | NP—7752459 |
| DE87752460 | CONF-8510450—Exc. |
| DE87752472 | NEI-DK—28 |
| DE87752473 | NEI-DK—27 |
| DE87752474 | NEI-DK—21 |
| DE87752475 | NEI-DK—29 |
| DE87752476 | DTH-IMSOR-RR—1986-4 |
| DE87752477 | TKK-KO/LVI—B11 |
| DE87752478 | TKK-KO/LVI—B12 |
| DE87752479 | TKK-KO/LVI—C36 |
| DE87752480 | VTT-TIED—669 |
| DE87752481 | VTT-TUTK—455 |
| DE87752482 | VTT-TIED—649 |
| DE87752483 | IVO-A—07/86 |
| DE87752484 | PFO—1410 |
| DE87752485 | IKU-R—05.1704.00/01/84 |
| DE87752486 | RF-T—41/84 |
| DE87752487 | RF-T—45/84 |
| DE87752488 | CMI-R—852243-2 |
| DE87752489 | CMI-R—852310-3 |
| DE87752490 | CMI-R—852310-5 |
| DE87752491 | CMI-R—852310-6 |
| DE87752492 | CMI-R—852330-8 |
| DE87752493 | CMI-R—862333-3 |
| DE87752494 | EFI-TR—3336 |
| DE87752495 | NIVA-O—82073 |
| DE87752496 | NLH/IBT/R—196 |
| DE87752498 | STF—21A85102 |
| DE87752499 | STF—21A85024 |
| DE87752500 | NILU-F—18/84 |
| DE87752501 | NIVA-O—82007 |
| DE87752624 | ENEA-RT-COMB—86-1 |
| DE87752625 | ENEA-RT/STUDI—85-3 |
| DE87752626 | ENEA-RT/FARE—86-7 |
| DE87752627 | ENEA-RT/FARE—86-8 |
| DE87752628 | ENEA-RT/FARE—84-4 |
| DE87752630 | ENEA-RT/FARE—85-3 |
| DE87752631 | ENEA-RT-FUS—86-7 |
| DE87752632 | ENEA-RT-TIB—86-61 |
| DE87752633 | ENEA-RT-TIB—86-37 |
| DE87752634 | ENEA-RT-TIB—86-38 |
| DE87752635 | ENEA-RT-TIB—86-53 |
| DE87752636 | ENEA-RT-TIB—86-43 |
| DE87752637 | ENEA-RT-TIB—86-42 |
| DE87752638 | ENEA-RT-TIB—86-44 |
| DE87752639 | ENEA-RT-TIB—86-59 |
| DE87752640 | ENEA-RT-FUS—86-12 |
| DE87752641 | ENEA-RT/STUDI—86-3 |
| DE87770107 | NP—7770107 |
| DE87770108 | NP—7770108 |
| DE87770109 | NP—7770109 |
| DE87770110 | NP—7770110 |
| DE87770111 | NP—7770111 |
| DE87770112 | NP—7770112 |
| DE87770113 | NP—7770113 |
| DE87770114 | NP—7770114 |
| DE87770115 | NP—7770115 |
| DE87770116 | NP—7770116 |
| DE87770117 | NP—7770117 |
| DE87770118 | NP—7770118 |
| DE87770119 | NP—7770119 |
| DE87770120 | NP—7770120 |
| DE87770121 | NP—7770121 |
| DE87770122 | NP—7770122 |
| DE87770123 | NP—7770123 |
| DE87770124 | NP—7770124 |
| DE87770125 | NP—7770125 |
| DE87770135 | NP—7770135 |
| DE87770170 | BMFT-FB-T—86-158 |
| DE87770171 | BMFT-FB-T—86-147 |
| DE87770172 | BMFT-FB-T—86-136 |
| DE87770173 | BMFT-FB-T—86-131 |
| DE87770174 | BMFT-FB-T—86-125 |
| DE87770175 | DFVLR-FB—87-04 |
| DE87770176 | IIUG-rep—85-11 |
| DE87770177 | IIUG-rep—86-8 |
| DE87770178 | Juel—2090 |
| DE87900540 | NUREG—0940-Vol.5-No.4 |
| DE87900761 | AERE-R—10812-Rev. |
| DE87900771 | NUREG—0750-Vol.24-Index.1 |
| DE87900796 | NP—7900796 |
| DE87900800 | IFUSP-P—524 |
| DE87900808 | BARC—1278 |
| DE87900811 | NMRDI—2-74-4625 |
| DE87900816 | NZERDC-P—114 |
| DE87900818 | IEA-SHAC-TVI—2 |
| DE87900821 | NZERDC-P—116 |
| DE87900827 | IEA-SHAC-TVI—3 |
| DE87900834 | NP—7900834 |
| DE87900839 | NUREG—0540-Vol.9-No.4 |
| DE87900851 | TVA/ONRED/AWR—87/6 |
| DE87900852 | TVA/ONRED/AWR—87/25 |
| DE87900854 | NUREG—0750-Vol.25-No.1 |
| DE87900883 | TVA/ONRED/WRF—85/1b |
| DE87900884 | TVA/PUB—87/18 |
| TI87000258 | BNL-NUREG—39134 |
| TI87006889 | NUREG/CR—2000-Vol.6-No.1 |
| TI87007999 | NUREG/CR—4617 |
| TI87008181 | NUREG/CR—4098 |
| TI87008297 | NUREG/CR—2000-Vol.6-No.2 |
| TI87009181 | NUREG/CR—4615-Vol.2 |
| TI87009373 | NUREG/CR—4860 |
| TI87010608 | NUREG/CR—4964 |
| TI87010610 | NUREG/CR—4674-Vol.3 |
| TI87010662 | NUREG/CR—4679 |
| TI87010663 | NUREG/CR—4681 |
| TI87010664 | NUREG/CR—4772 |
| TI87010665 | NUREG/CR—4830 |
| TI87010676 | NUREG/CR—4165 |
| TI87010755 | BNL-NUREG—39849 |
| TI87010786 | NUREG/CR—4892 |
| TI87010802 | NUREG/CR—3231 |
| TI87010804 | NUREG/CR—2000-Vol.6-No.4 |
| TI87011019 | NUREG/CR—4653 |
| TI87011275 | NUREG/CR—4897 |
| TI87011649 | CONF-851217—70 |
| TI87900596 | NUREG/CR—4082-Vol.5 |
| TI87900645 | TR-EL—82-4/82-11-72 |
| TI87900762 | NUREG—1259 |
| TI87900765 | NUREG—1272 |
| TI87900768 | NUREG/CR—4903-Vol.3 |
| TI87900769 | NUREG/CR—4783 |
| TI87900774 | NUREG—0540-Vol.9-No.2 |
| TI87900776 | NUREG—0728-Rev.2 |
| TI87900799 | IEA/ICTIS/TR—37 |
| TI87900813 | NUREG—1147-Rev.1 |
| TI87900824 | NUREG/CR—4928 |
| TI87900829 | NCRP—88 |
| TI87900837 | NUREG—0936-Vol.6-No.1 |
| TI87900844 | IEA/ICEAS/B—4 |
| TI87900845 | NCRP—87 |
| TI87900879 | NUREG/CR—4726 |
| TI87920306 | EPRI-NP—5054-SR |
| TI87920331 | EPRI-NP—4993 |
| TI87920348 | EPRI-NP—4696-CCM-Vol.2 |
| TI87920436 | EPRI-EL—3359-Vol.3 |
| TI87920453 | EPRI-EM—5226 |
| TI87920454 | EPRI-NP—5150-M |
| TI87920455 | EPRI-NP—5228-Vol.2 |
| TI87920456 | EPRI-NP—5228-Vol.1 |
| TI87920460 | EPRI-AP—5220 |
| TI87920466 | EPRI-EL—4286-Vol.5 |
| TI87920467 | EPRI-EA—5115 |
| TI87920470 | EPRI-EA—5202 |
| TI87920472 | EPRI-EM—5232 |
| TI87920473 | EPRI-AP—5247 |
| TI87920474 | EPRI-EL—5179 |
| TI87920478 | EPRI-AP—5276 |
| TI87920480 | EPRI-EM—5175 |
| TI87920482 | EPRI-EM—5231 |
| TI87920485 | EPRI-EM—5274 |
| TI87920490 | EPRI-P—5201 |
| TI87920492 | EPRI-CS—5198-Vol.2 |
| TI87920493 | EPRI-CS—5198-Vol.3 |
| TI87920494 | EPRI-P—5284 |
| TI87920500 | EPRI-CS—5235 |
| TI87920506 | EPRI-P—5160-SR |

# AVAILABILITY OF REFERENCES ABSTRACTED

## REPORTS

A document cited in this publication is considered a "report" when it carries a unique identifying number (e.g., ANL-3130, BNL-4000, DP-150, etc.) as the first element of the citation. Usually, one or more of the following abbreviations will appear at or near the end of the citation, indicating the organization from which the document is available. If none of these abbreviations appears, the report should be requested from either the cited publisher or corporate source.

GPO — Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

GPO Dep. — Available for inspection or interlibrary loan at GPO depository libraries. Unlimited DOE reports are being sent to the GPO depository libraries. See inside back cover for list of the libraries. These reports are identified by report number, Supt. of Docs. Class Number (E 1.99:) and OSTI accession/file number, e.g., DE87003384.

NTIS — For sale by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. Paper copy (PC) and other price codes are for domestic users; prices for foreign purchasers are, in most instances, twice the domestic price. There is only one microfiche (MF) price code, MF A01 ($6.50).

OSTI — Available from the Office of Scientific and Technical Information (OSTI), U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831, Attn: Technical Information Division.

**NOTE:** DOE offices and contractors should order reports from OSTI; all others should order from NTIS. For additional information, see the introductory paragraph to the Report Number Index.

## NTIS NORTH AMERICAN PRICE CODES

Most NTIS products and services are now announced by price codes and, therefore, without specific prices in NTIS journals, newsletters, and indexes.

The current dollar equivalent for each code is shown in the schedule below. Orders must list the accession number(s) and be accompanied by the total dollar amount from the current schedule.

**NORTH AMERICAN CONTINENT PRICE SCHEDULE**

**Customers in Canada, United States, and Mexico, please use this price schedule; other addressees, write for PR-360-4.**

| MICROFICHE | EXCEPTIONAL | MAGNETIC TAPES | DISKETTES |
|---|---|---|---|
| A01.....$6.50 | E01.....$7.50 | T01.....$150.00 | D01.....$ 50 |
| PAPER COPY | E02.....10.50 | T02.....175.00 | D02..... 75 |
| A02.....$9.95 | E03.....11.00 | T03.....300.00 | D03..... 125 |
| A03.....11.95 | E04.....13.50 | T04.....400.00 | D04..... 175 |
| A04.....13.95 | E05.....15.50 | T05.....500.00 | D05..... 225 |
| A05.....13.95 | E06.....18.00 | T06.....600.00 | D06..... 275 |
| A06.....18.95 | E07.....20.50 | T07.....700.00 | D07..... 325 |
| A07.....18.95 | E08.....23.00 | T08.....800.00 | D08..... 375 |
| A08.....18.95 | E09.....25.50 | T09.....900.00 | D09..... 425 |
| A09.....18.95 | E10.....28.00 | T10.....1,000.00 | D10..... 475 |
| A10.....24.95 | E11.....30.50 | T11.....1,100.00 | D11..... 525 |
| A11.....24.95 | E12.....33.00 | T12.....1,200.00 | D12..... 575 |
| A12.....24.95 | E13.....35.50 | T13.....1,300.00 | D13..... 625 |
| A13.....24.95 | E14.....38.50 | T14.....1,400.00 | D14..... 675 |
| A14.....30.95 | E15.....42.00 | T15.....1,500.00 | D15..... 725 |
| A15.....30.95 | E16.....46.00 | T16.....1,600.00 | D16..... 775 |
| A16.....30.95 | E17.....50.00 | T17.....1,700.00 | D18..... 875 |
| A17.....30.95 | E18.....54.00 | T18.....1,800.00 | D19..... 925 |
| A18.....36.95 | E19.....60.00 | T19.....1,900.00 | |
| A19.....36.95 | E20.....70.00 | T99..... * | |
| A20.....36.95 | E99..... * | | |
| A21.....36.95 | N01.....$45.00 | | |
| A22.....42.95 | N02.....48.00 | | |
| A23.....42.95 | | | |
| A24.....42.95 | | | |
| A25.....42.95 | | | |
| A99..... * | | | |

*Contact NTIS for price quote.

PRICES EFFECTIVE JANUARY 1, 1987

**U. S. DEPARTMENT OF COMMERCE**

**National Technical Information Service**

**5285 Port Royal Road, Springfield, Virginia 22161**

## NON-REPORT DOCUMENTS

**BOOKS**

Most books cited are available from commercial publishers. Order from the publisher or other source as given, not from OSTI.

**CONFERENCE PAPERS**

Individual conference papers (or preprints) not available as reports should be requested from the originator or other source as cited.

**CONFERENCE PROCEEDINGS**

Many proceedings are available from commercial publishers; in other cases, request from the society, organization, institution, etc., cited as the source.

**DISSERTATIONS (THESES)**

Available from University Microfilms International, Dissertation Copies, P. O. Box 1764, Ann Arbor, MI 48106. Request by order number cited, e.g., 87-22,350.

**JOURNAL ARTICLES**

Users must use their own resources to obtain (or scan) articles cited—local, state, or university libraries or publishers, reprint services, etc.

**MONOGRAPHS**

Request from the organization, institution, society, etc., responsible for the monograph.

**PATENTS**

Although not cataloged as reports, patents cited from each country are listed in the Report Number Index under PATENTS-AU, PATENTS-FR, PATENTS-US, etc. U. S. Patent Applications (e.g., A 293,415) are available from NTIS.

# CODES USED ON INDEX LINES

Following the citation numbers in the Corporate Author, Personal Author, and Subject Indexes, codes are used to designate the type of document, country of publication, and language of the document, e.g., (R;SU;RU). The language designator does not appear if the document is published in English.

## DOCUMENT TYPES

| | |
|---|---|
| J | Journal article |
| TJ | Translation of a journal article |
| R | Report |
| RA | Report analytic |
| B | Book |
| BA | Book analytic |
| P | Patent |
| E | Engineering materials |
| D | Dissertation |
| TG | Translation (general) |
| TA | Translation (analytic) |

## COUNTRY CODES

| | |
|---|---|
| AD | Andorra |
| AE | United Arab Emirates |
| AF | Afghanistan |
| AL | Albania |
| AR | Argentina |
| AT | Austria |
| AU | Australia |
| BB | Barbados |
| BD | Bangladesh |
| BE | Belgium |
| BG | Bulgaria |
| BH | Bahrain |
| BI | Burundi |
| BJ | Benin |
| BM | Bermuda |
| BO | Bolivia |
| BR | Brazil |
| BS | Bahamas |
| BT | Bhutan |
| BU | Burma |
| BW | Botswana |
| BY | Byelorussian Soviet Socialist Republic (Byelorussian SSR) |
| CA | Canada |
| CB | Khmer Republic |
| CF | Central African Republic |
| CG | Congo |
| CH | Switzerland |
| CI | Ivory Coast |
| CL | Chile |
| CM | United Republic of Cameroon |
| CN | China |
| CO | Colombia |
| CR | Costa Rica |
| CS | Czechoslovakia |
| CU | Cuba |
| CY | Cyprus |
| DD | German Democratic Republic |
| DE | Germany, Federal Republic of (F.R. Germany) |
| DK | Denmark |
| DO | Dominican Republic |
| DZ | Algeria |
| EC | Ecuador |
| EG | Egypt |
| ES | Spain |
| ET | Ethiopia |
| FI | Finland |
| FJ | Fiji |
| FR | France |
| GA | Gabon |
| GB | United Kingdom of Great Britain and Northern Ireland (UK) |
| GD | Grenada |
| GH | Ghana |
| GM | Gambia |
| GN | Guinea |
| GQ | Equatorial Guinea |
| GR | Greece |
| GT | Guatemala |
| GU | Guam |
| GW | Guinea-Bissau |
| GY | Guyana |
| HK | Hong Kong |
| HN | Honduras |
| HT | Haiti |
| HU | Hungary |
| HV | Upper Volta |
| ID | Indonesia |
| IE | Ireland |
| IL | Israel |
| IN | India |
| IQ | Iraq |
| IR | Iran |
| IS | Iceland |
| IT | Italy |
| JM | Jamaica |
| JO | Jordan |
| JP | Japan |
| KE | Kenya |
| KH | Democratic Kampuchea |
| KP | Democratic People's Republic of Korea |
| KR | Korea, Republic of |
| KW | Kuwait |
| LA | Laos |
| LB | Lebanon |
| LI | Liechtenstein |
| LK | Sri Lanka |
| LR | Liberia |
| LS | Lesotho |
| LU | Luxembourg |
| LY | Libyan Arab Republic |
| MA | Morocco |
| MC | Monaco |
| MG | Madagascar |
| ML | Mali |
| MN | Mongolia |
| MR | Mauritania |
| MT | Malta |

| | |
|---|---|
| MU | Mauritius |
| MV | Maldives |
| MW | Malawi |
| MX | Mexico |
| MY | Malaysia |
| NE | Niger |
| NG | Nigeria |
| NI | Nicaragua |
| NL | Netherlands |
| NO | Norway |
| NP | Nepal |
| NR | Nauru |
| NZ | New Zealand |
| OM | Oman |
| PA | Panama |
| PE | Peru |
| PG | Papua New Guinea |
| PH | Philippines |
| PK | Pakistan |
| PL | Poland |
| PR | Puerto Rico |
| PT | Portugal |
| PY | Paraguay |
| QA | Qatar |
| RH | Southern Rhodesia |
| RO | Romania |
| RW | Rwanda |
| SA | Saudi Arabia |
| SD | Sudan |
| SE | Sweden |
| SG | Singapore |
| SK | Sikkim |
| SL | Sierra Leone |
| SM | San Marino |
| SN | Senegal |
| SO | Somalia |
| SU | Union of Soviet Socialist Republics (USSR) |
| SV | El Salvador |
| SY | Syria |
| SZ | Swaziland |
| TD | Chad |
| TG | Togo |
| TH | Thailand |
| TN | Tunisia |
| TO | Tonga |
| TR | Turkey |
| TT | Trinidad and Tobago |
| TW | Taiwan |
| TZ | United Republic of Tanzania |
| UA | Ukrainian Soviet Socialist Republic (Ukrainian SSR) |
| UG | Uganda |
| US | United States of America (USA) |
| UY | Uruguay |
| VA | Holy See |
| VE | Venezuela |
| VI | Virgin Islands of the United States |
| VN | Viet Nam |
| WS | Western Samoa |
| YD | Democratic Yemen |
| YE | Yemen |
| YU | Yugoslavia |
| ZA | South Africa |
| ZM | Zambia |
| ZR | Zaire |
| ZW | Zimbabwe |

## LANGUAGE CODES

| | |
|---|---|
| BE | Belorussian |
| BU | Bulgarian |
| CH | Chinese |
| CZ | Czech |
| DA | Danish |
| DU | Dutch |
| FI | Finnish |
| FL | Flemish |
| FR | French |
| GE | German |
| HE | Hebrew |
| HI | Hindi |
| HU | Hungarian |
| IR | Iranian |
| IT | Italian |
| JA | Japanese |
| KO | Korean |
| NO | Norwegian |
| PO | Polish |
| PT | Portuguese |
| RN | Rumanian |
| RU | Russian |
| SC | Serbo-Croatian |
| SE | Slovene |
| SP | Spanish |
| SV | Slovak |
| SW | Swedish |
| TH | Thai |
| TU | Turkish |
| UK | Ukrainian |
| VT | Vietnamese |

☆ U.S. GOVERNMENT PRINTING OFFICE: 1987-748-167/60010

CUT OUT APPROPRIATE FORM AND MAIL IN A STAMPED ENVELOPE TO THE ADDRESS INDICATED.

## *Change of Address Form*

NAME—FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

(or) COUNTRY

MAIL THIS FORM TO:

NEW ADDRESS
Superintendent of Documents
Government Printing Office SSOM
Washington, D.C. 20402

Attach last subscription label here.

## *Subscription Order Form*

Enter my Subscription to: _____

*(Please indicate publication)*

@ $_____ Domestic; @ $_____ Foreign.

NAME—FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

(or) COUNTRY

☐ Remittance Enclosed (Make checks payable to Superintendent of Documents)

☐ Charge to my Deposit Account No._____

MAIL ORDER FORM TO:
Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

# FEDERAL DEPOSITORY LIBRARY PROGRAM

As a result of an agreement between the U. S. Government Printing Office (GPO) and the Department of Energy, beginning in 1984 DOE reports with unlimited distribution are now included in the Federal Depository Library Program. The Regional Depository Libraries listed below receive and retain at least one copy of nearly every Federal Government publication, either in printed or microfilm form, for use by the general public. These libraries provide reference services and interlibrary loans; however, they are *not* sales outlets. You may wish to ask your local library to contact a Regional Depository to help you locate specific publications, or you may contact the Regional Depository yourself. Do not send checks or orders to these libraries.

**ARKANSAS STATE LIBRARY**
One Capitol Mall
Little Rock, AR 72201
(501) 371-2326

**AUBURN UNIV. AT MONTGOMERY LIBRARY**
Documents Department
Montgomery, AL 36193
(205) 279-9110, ext. 253

**UNIV. OF ALABAMA LIBRARY**
Documents Dept.-Box S
University, AL 35486
(205) 348-7369

**DEPT. OF LIBRARY, ARCHIVES AND PUBLIC RECORDS**
Third Floor-State Cap.
1700 West Washington
Phoenix, AZ 85007
(602) 255-4121

**UNIVERSITY OF ARIZONA LIB.**
Governments Documents Dept.
Tucson, AZ 85721
(602) 626-5233

**CALIFORNIA STATE LIBRARY**
Govt. Publications Section
P.O. Box 2037
Sacramento, CA 95809
(916) 322-4572

**UNIV. OF COLORADO LIB.**
Government Pub. Division
Campus Box 184
Boulder, CO 80309
(303) 492-8834

**DENVER PUBLIC LIBRARY**
Govt. Pub. Department
1357 Broadway
Denver, CO 80203
(303) 571-2131

**CONNECTICUT STATE LIBRARY**
Government Documents Unit
231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971

**UNIV. OF FLORIDA LIBRARIES**
Library West
Documents Department
Gainesville, FL 32611
(904) 392-0367

**UNIV. OF GEORGIA LIBRARIES**
Government Reference Dept.
Athens, GA 30602
(404) 542-8951

**UNIV. OF HAWAII LIBRARY**
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230

**UNIV. OF IDAHO LIBRARY**
Documents Section
Moscow, ID 83843
(208) 885-6344

**ILLINOIS STATE LIBRARY**
Information Services Branch
Centennial Building
Springfield, IL 62706
(217) 782-5185

**INDIANA STATE LIBRARY**
Serials Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

**UNIV. OF IOWA LIBRARIES**
Govt. Documents Department
Iowa City, IA 52242
(319) 353-3318

**UNIVERSITY OF KANSAS**
Doc. Collect.-Spencer Lib.
Lawrence, KS 66045
(913) 864-4662

**UNIV. OF KENTUCKY LIBRARIES**
Govt. Pub. Department
Lexington, KY 40506
(606) 257-3139

**LOUISIANA STATE UNIVERSITY**
Middleton Library
Govt. Docs. Dept.
Baton Rouge, LA 70803
(504) 388-2570

**LOUISIANA TECHNICAL UNIV. LIBRARY**
Documents Department
Ruston, LA 71272
(318) 257-4962

**UNIVERSITY OF MAINE**
Raymond H. Fogler Library
Tri-State Regional Documents Depository
Orono, ME 04469
(207) 581-1680

**UNIVERSITY OF MARYLAND**
McKeldin Lib.-Doc. Div.
College Park, MD 20742
(301) 454-3034

**BOSTON PUBLIC LIBRARY**
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext. 226

**DETROIT PUBLIC LIBRARY**
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

**MICHIGAN STATE LIBRARY**
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

**UNIVERSITY OF MINNESOTA**
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

**UNIV. OF MISSISSIPPI LIB.**
Documents Department
University, MS 38677
(601) 232-5857

**UNIV. OF MONTANA**
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

**NEBRASKA LIBRARY COMM.**
Federal Documents
1420 P Street
Lincoln, NE 68508
(402) 471-2045
(in cooperation with University of Nebraska-Lincoln)

**UNIVERSITY OF NEVADA LIB.**
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

**NEWARK PUBLIC LIBRARY**
5 Washington Street
Newark, NJ 07101
(201) 733-7812

**UNIVERSITY OF NEW MEXICO**
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

**NEW MEXICO STATE LIBRARY**
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

**NEW YORK STATE LIBRARY**
Empire State Plaza
Albany, NY 12230
(518) 474-5563

**UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

**UNIVERSITY OF NORTH DAKOTA**
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(in cooperation with North Dakota State Univ. Library)

**STATE LIBRARY OF OHIO**
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

**OKLAHOMA DEPT. OF LIBRARIES**
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

**OKLAHOMA STATE UNIV. LIB.**
Documents Department
Stillwater, OK 74078
(405) 624-6546

**PORTLAND STATE UNIV. LIB.**
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

**STATE LIBRARY OF PENN.**
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

**TEXAS STATE LIBRARY**
Public Services Department
P.O. Box 12927-Cap. Sta.
Austin, TX 78753
(512) 471-2996

**TEXAS TECH. UNIV. LIBRARY**
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

**UTAH STATE UNIVERSITY**
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

**UNIVERSITY OF VIRGINIA**
Alderman Lib.-Public Doc.
Charlottesville, VA 22901
(804) 924-3133

**WASHINGTON STATE LIBRARY**
Documents Section
Olympia, WA 98504
(206) 753-4027

**WEST VIRGINIA UNIV. LIB.**
Documents Department
Morgantown, WV 26506
(304) 293-3640

**MILWAUKEE PUBLIC LIBRARY**
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

**ST. HIST. LIB. OF WISCONSIN**
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

**WYOMING STATE LIBRARY**
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
(307) 777-6344

United States Department of Energy
Office of Scientific and Technical Information
Post Office Box 62
Oak Ridge, Tennessee 37831

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF ENERGY
DOE-350

U.S. MAIL

FS- 1

3227
UNIV MICROFILMS INTERNATIONAL
ATTN SERIALS PROCESSING
300 NORTH ZEEB RD
ANN ARBOR, MI 48106

SPECIAL FOURTH

U.S. OFFICIAL MAIL
PENALTY FOR PRIVATE USE $300
POSTAGE AND FEES PAID
DEPARTMENT OF ENERGY
DOE-350

KNOXVILLE TENN
OCT 19 '87

$1.04